Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

September 29, 1921

Engineering News-Record

For the Average Engineer

A Dozen Short Articles Telling How to Solve Some Every-Day Problems of Field and Office

Also In This Issue:

Practical Economics of Dredge Pump Design

Smooth flow lines require less power—Wear reduced and output increased—Two designs compared on actual work.

By E. J. Dent

Eight-Cable Suspension Bridge of 1803-Foot Span for Detroit

Double-deck construction to accommodate railway and highway traffic

Detours Part of Service-to-Traffic Policy

Wayne County (Mich.) Commission provides many temporary routes—Some at river crossings.

By Edward N. Hines

100 Percent Efficient

Under all kinds of traffic and climatic conditions the Lug is a strong factor of safety.

The flexibility of the blocks under expansion, when laid with an open joint Kreolite Lug Construction, prevents the possibility of buckling, the wedge shaped lugs compressing when the blocks expand.

The lugs permit the bituminous filler to penetrate the full depth of the blocks on all sides, thus making a wear and waterproof pavement.

The compression of the lugs under expansion also retards bleeding.

The lugs afford a foothold for horses and automobiles equipped with tire chains.

Let our experts help you solve your paving troubles. They will gladly help you on request.

The Jennison-Wright Company, 79 Kreolite Building, Toledo, Ohio

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 87 — NEW YORK, SEPTEMBER 29, 1921 — Number 13

B. Coli Still Supreme

BY A PEN SLIP B. Welchii instead of B. Coli, was said on p. 470 of last week's editorial page to still stand supreme as a test for public water supplies. As the context, the article by Sir Alexander Houston in the same issue, and the opinions and editorial comment published in our issues of June 2 and 9 all emphatically show, the paragraph should have read: "Meanwhile, we join with an undoubtedly large majority of American and Canadian water-works men in agreeing with Sir Alexander that the B. Coli test still stands supreme."

Advertising Its Engineers

NO EASTERN railway has done more of the pioneer type of engineering improvement in recent years than the Lackawanna. Other roads have built larger terminals and more elaborate stations, but the Lackawanna's revision of line and grade with mammoth fills, large masonry bridges, and deep and long cuts have kept its engineers busy for a decade or more. Engineers have recognized that this work has been well done but the traveling public has probably taken it as a matter of course; certainly it has not received the publicity accorded the fancy passenger stations of our larger cities. In resuming its famous "Phoebe Snow" advertising the Lackawanna is now turning the spotlight on what it calls the "engineering triumphs" of the road and is giving public credit to what its engineers have accomplished. Those who read the advertisements will appreciate now, perhaps, that railroad efficiency is not entirely the product of the operator, but that even with a road once built the engineer is a constant factor.

Tax Relief as a Business Stimulant

BOTH the Republican and the Democratic parties during the Presidential campaign of 1920 were insistent that the excess-profits tax was a hindrance to business and a cause of high prices. Both pledged themselves to its repeal and the substitution of a tax less discouraging to business, more simple of computation, and not stimulative of inordinate price increases. Since March 4 the Republicans have been in a position to carry out their campaign pledge. The situation today, after seven months of opportunity, indicates a probable repudiation of that promise to the extent of postponing the appeal of the excess-profits tax for one year, making it effective Jan. 1, 1922, instead of Jan. 1, 1921. If industrial leaders are to be believed regarding the effect of the excess-profits tax in their own businesses, there has been no more fruitful cause of high prices than that measure. High prices and the discouragement due to the taking of these profits are factors in preventing the rapid resumption of business. Congress, if it be sincerely interested in a business revival, might well do its part by carrying out the joint Democratic and Republican pledge of the fall of 1920. When it is argued as it is by Congressman Mann, that the industries have set their prices this year with the expectation of paying an excess-profits tax, there is indicated a woeful lack of appreciation of the methods of operating industrial and business corporations. Taxes are paid not out of reserves built up the previous year, but out of the earnings of the year in question. The effect of a retention of the excess-profits tax will be to continue its blighting influence for the whole of 1922.

Largest Activated-Sludge Plant

A CONTRACT notable in size and of unusual significance in purpose is soon to be let at Milwaukee. It embraces the aeration and sedimentation tanks and the pipe galleries for the large activated-sludge plant which will treat the sewage of Milwaukee. This plant will be by far the largest of its kind yet undertaken, or for that matter seriously proposed. Its design follows what is probably the most intense and extended experimental investigation ever made preparatory to adopting final plans for sewage-works. The completion of the plant will mark an epoch in sewage treatment.

The Rust Devils

THE FAILURE of the kitchen ceiling slab at the Marlborough-Blenheim at Atlantic City has started a whole train of examples of the corrosion of reinforcement in concrete subject to moisture. Two of these only are given in this issue, not because they exhibit any extraordinary conditions, but because, as Professor McKibben intimates, it is a good thing to remind ourselves of the dangers of porous concrete and of the ease with which percolation and consequent corrosion can occur. Probably the average concrete of today is better than the best of ten years ago and more proof against the attacks of moist air, be it salt or fresh, but there is still a lot of poor concrete being placed. Those who neglect the necessary precautions to insure dense, strong concrete cannot expect to produce long-lived structures. The rust devils work slowly but they are persistent and powerful. Give them an opportunity to penetrate the armor of concrete and the reinforced structure is doomed.

Practical Dredge Pump Design

CENTRIFUGAL pump design, as it concerns the dredge operator, is emphasized in the article by Col. E. J. Dent. He urges dredge operators to be more critical of hydraulic design instead of concerning themselves so exclusively with questions of wear-resisting materials and of construction which permits the quick replacement of worn parts. This stand is well taken. Perplexed by the pump-maker's talk of vane angles, exit and entrance velocities and flow spirals, the dredge operator has come to consider hydraulic design a specialty in which he cannot qualify. Furthermore, his observation of impeller blades worn to a frazzle after handling coarse gravel for a few days, has led him to

be rather contemptuous of refinements of hydraulic design. It is the merit of Colonel Dent's article that it helps the dredge operator to see more clearly that hydraulic design is not a problem outside his province and that intelligent refinement is a practicable, money-saving possibility. He has done this with facts on which the dredge-user can place a value.

Overloading Convention Programs

THE PREPARATION of a program for an engineering society convention is, at best, a thankless task—it is far easier to criticize than to offer constructive suggestions. The trouble with a great many society programs in the past has been a total lack of appreciation on the part of the local committee on arrangements of the amount of time available for technical papers and committee reports. Generally far more material has been scheduled for presentation than could possibly be disposed of. The result has been that many engineers, on receiving in advance the programs of such meetings, have attended, on a certain day, in the hope of hearing some report or paper on the particular subject in which they are interested. They find, after arrival, that due to delays in carrying out the program the subject which they made the trip to hear about has either been crowded off the schedule or possibly postponed until the last day. Waste of time, money expended in railroad fares and hotel bills, to say nothing of the strain on a man's temper, have often been the net results of such proceedings. In the past the American Society for Municipal Improvements, which holds its annual convention at Baltimore next month, has been an offender of this sort. Last year, however, an attempt was made to introduce more business-like methods of handling the convention by segregating subjects and holding section meetings. The move was a good one and should be continued. At this year's convention some one should scrutinize the program carefully in advance, estimate the time required for the delivery of papers and reports, and make a reasonable allowance for discussion from the floor. It may then appear that the program, as originally drafted, is too heavy and cut in it may accordingly be made before the meeting.

Making Meters Misdemeanors

OF ALL the ignorant opposition to water meters that crops up at intervals none exceeds that recently displayed at Stockton, Cal., where the City Council has passed an ordinance declaring it "unlawful and a misdemeanor" to install a meter to measure water to be consumed by any person or corporation. The penalty is a fine of not over $500 or imprisonment for not more than 180 days. Apparently, the city fathers of Stockton made the ordinance an emergency measure, or else sought to fortify themselves against legal attack, for the ordinance solemnly declares that it was "framed for the immediate preservation of the public health and safety of the city of Stockton, and is urgently required for the reason that the use of said meters creates an additional fire hazard and is detrimental to the public safety." This is enough to make one laugh or cry, according to whether he views the matter subjectively or objectively—as an example of men making a spectacle of themselves or out of sympathy for the people of a city governed by a body having so little information and judgment. Fortunately, the ordinance is to be reviewed by the Railroad Commission of California.

Cinders in Roadmaking

THE account in the last issue of the use of cinders for building an oil-treated road in the Borough of Queens, New York City, recalls the common use in England of cinders for quite another road-building purpose. Attention has previously been called to this use of cinders in England, but the idea never seems to have caught hold in American highway engineering circles. The use referred to is that of affording a stop to the rise of a clay sub-base into macadam road crusts. In our own highway practice we know how very difficult it is to prevent clay working upward through any crust, with the exception of a concrete wearing slab or concrete base. In England, after experiment with various kinds of materials, it is the practically universal belief that nothing is quite so effective as a layer of cinders to prevent the clay from working upward. So general is this view held in England that the use of cinders may well be tried for the same purpose in our American practice where this waste product can be laid on the road at low cost.

The Engineer's Counsel Needed

AS WAS TO BE EXPECTED as a result of the expansion of industrial plants to meet war's needs, there has come about intensive study of many manufacturers of fields into which they might well extend their endeavors. We learn of shipbuilding companies engaging in the fabrication of bridge and building steel; manufacturers of hoists for a specialized purpose adding lines applicable to other uses, and machines hitherto found only in one field being introduced into others. These developments, of course, were going on steadily and continuously even before the war. The war merely accelerated these expansion activities. In cases that have come to our attention the excursions into other fields, are going on in a rather lame way. A "first-class salesman" who is supposed to know the field into which it is desired to expand seems to be, in these instances, the sole reliance of the optimistic manufacturer. In one such case recently the manufacturer after months of endeavor was ready to throw up his hands and cease his activities when a friend suggested that what he needed was to secure an engineer thoroughly familiar with the new industry and place upon him the responsibility of a broad promotion and sales policy. The recommendation was adopted and the results, considering the slackness of business, encouraging. The thought might well be passed along to other manufacturers who are seeking expansion.

Discounting the Snow Problem

DURING the warm days of summer hardly anybody thinks of the problem of snow removal. Yet that is just the time when a workable solution may best be arrived at, for last-minute planning is of little avail. The success of all municipal snow-removal operations depends essentially on the organization of the work and the provision of the necessary personnel and mechanical equipment well in advance of winter. This fact has been realized by the American Society of Mechanical Engineers which, through the medium of its Material Handling Section, devoted last week's meeting in New York to a forum on snow-removal methods and machines, at which not only members of the society but representatives of the city administration expressed their views. Due largely to the extreme use of

mechanical equipment last year, New York handled its snow more expeditiously than during other periods in the past when hand labor and horse-drawn carts were the only tools with which work could be done. There is, however, still room for a vast amount of improvement, particularly in the application of mechanical devices to the problem.

Last week's meeting of the mechanical engineers was noteworthy for the occasion it offered for suggestions as to improved types of snow-handling machinery. During the last year or two mechanical loaders of the inclined conveyor type have given promise of usefulness, and, in New York, an extensive use of motor trucks and tractors of the caterpillar type equipped with push-plows or blade-graders, were successful. Little progress has been made in reducing the volume of snow before handling, and it was this phase of snow removal which received a considerable amount of attention at last week's meeting. It was brought out, in fact, that more than forty years ago Thomas A. Edison had developed a briquetting machine which he has never perfected, due to the press of other work. If a reasonably priced briquetting machine can be produced which is workable in practice as well as in theory, it would be a great relief to traffic tie-ups caused by heavy falls of snow. A successful briquetting machine would mean, in fact, that the volume of snow on the city streets could be reduced about nine-tenths by compressing the snow into cubes, which could be either piled along the street or removed in motor trucks.

Until recently snow removal was never regarded as a job for engineers. The hopeful feature of last week's meeting is that many engineers have now recognized the field of snow handling as their own, and with the thought of the profession turned into this comparatively new channel important developments may be expected.

The Railroads' View of Motor-Vehicle Competition

THE matter of license fees for motor vehicles is never going to be settled until it is settled right. We do not believe that there can be any argument about that. Nor would any one contend that the present basis of fees is right, taking all of our states into consideration. A study of Mr. Tomlin's inquiry into motor-vehicle laws is convincing on that point. The taxpayers will keep up a certain amount of agitation, and their efforts will be abetted by another interest—the railroads—which being between the devil and the deep sea, have no alternative but to fight in any direction which gives promise of some relief.

The taxpayer contends that the vehicle should be obliged to pay a share of road cost proportionate to the benefit it receives—a demand susceptible of wide variation in interpretation, but carrying certain implications nevertheless. The railroads have a right to make the same demand, but they have an added reason for protest against present average fees since, as large taxpayers, they are helping to build up competition against themselves. Such competition for short-haul business, it is well known, has seriously cut into railroad revenues in the East, and particularly in New England and around New York City.

Against this competition, if on sound, economic grounds, the railroads cannot protest. But they declare that it is not on sound, economic grounds, and they advance the familiar argument that they must build and maintain their own tracks, while the public (with only slight offset in fees) maintain roads for the motor truck. They add to this contention arguments based on their rights as big taxpayers, and point out that the public has an added interest by reason of its holdings of railroad securities, both directly and through its large insurance reserves and savings bank investments. The value of these securities is likely to be further depreciated by truck competition, the railroads urge.

The case was argued from these angles by Edward G. Riggs, executive assistant of the New York, New Haven & Hartford R.R., in *The Forum* for June. Citing nineteen states, he showed that their tax collections from railroads are, with the exception of New York and Georgia, from 3 to 100 times what they are from the motor trucks (figures are not given for all motor vehicles). New Jersey's case is particularly flagrant. With over $10,000,000 collected by various public agencies from the railroads in 1920, only $654,000 was collected from motor trucks. Mr. Riggs does not contend that all the railroad taxes go into road-building. Local authorities use some of it for police and fire protection and the usual running expenses of county and town governments. Nevertheless, garages and trucks equally require these protective activities of the local authorities.

Mr. Riggs, too, is reasonable in his demand. He asks merely that the motor vehicle pay the cost of "keeping roads in repair once they are built," letting the first cost come out of taxation. Probably he would require that reconstruction, also, be provided out of the vehicle fees. He would thus merely align himself with the many authorities who contend for a similar distribution of road costs.

Another example of railroad viewpoint on highway matters is afforded by testimony by Stuart B. Moore, formerly a construction engineer on the Southern Pacific, before the Senate Committee on Interstate Commerce. Mr. Moore very wisely advocated systems of good roads radiating from commercial centers served by railroads. Such systems would develop the back country and serve as traffic feeders. He added, however, that he advocated such systems *rather than* "parallel lines of highways whose only service is to compete with the railroads."

Obviously, public authorities, while they may well think of making the highways supplementary to the railroads must provide parallel systems as well. In advocating the one alternative as against the other, Mr. Moore is not likely to find wide support. What he might well do, however, is to join with Mr. Riggs in demanding that motor-vehicle fees be put upon a basis that will be reasonable not merely in the public's interest but be sound, as well, from the standpoint of competing transportation mediums.

Mr. Tomlin's article in our issue of Sept. 1 has already furnished much food for thought, as is evident from the comments received in this office. There is groping, however, for information as to what the fees should properly be. More study is needed along these lines, and it will do good rather than harm for the railroads to bring pressure additional to that of the taxpayers. In the interest of the highways and of motor trucking, no less than that of the public and of the railways, a settlement of the fee problem on a more defensible basis than the present is demanded.

A Group of Articles for the "Average Engineer"

Concrete Chimney Design—Figuring Unstayed Beams—Using Stadia on Traverses—To Determine Hopper Slopes
How a Wooden Truss Failed—Fixing Highway Grades—Special Problem in Ground Arches—
How Curves Affect Channel Flow—Grade Line Adjustment—T-Beam Diagram

Short Cut Design of Concrete Chimneys

BY WILLIAM WALLACE CHRISTIE
Consulting Engineer, Ridgewood, N. J.

ONE of the easiest and most reliable methods of calculating the vertical steel for a concrete chimney is first to determine the thickness of a steel chimney of the required diameter and height, and then to divide the same amount of steel into bars properly spaced in an equivalent pitch circle. One formula which uses in its derivation 65,000 lb. sq.in. stress in steel and a factor of safety of 5 is as follows:

$$t_s = \frac{1}{D} \times \left(\frac{H}{100}\right)^3$$

where t_s = thickness of steel in inches, D = outside bottom diameter in feet, and H = height in feet.

Table I gives the results of calculating for t_s by this method.

TABLE I

Height, Ft.	Diameter in Feet					
	4	5	6	7	8	9	10
100	0.25	0.20	0.17	0.14	....	....	....
125	0.39	0.32	0.26	0.23	0.19	0.17	....
150	....	0.45	0.38	0.32	0.28	0.25	0.23
200	....	....	0.66	0.58	0.50	0.44	0.40
250	....	....	....	0.90	0.78	0.70	0.63

In 1902, some years before this table was published, the author prepared a table giving the thicknesses actually used in the construction of various chimneys that have stood the test of many years. For example, in a chimney 96 in. diameter by 215 ft. high, the 1902 table gives ½-in. thick steel, and Table I gives ½-in. thick for 200 ft. height. In another chimney 60 in. diameter by 150 ft. high, the 1902 table gives ⅜-in. steel for 145 ft. height and Table I 0.45-in. steel for 150 ft. high.

By using the above method for determining the amount of steel, the steel takes all of the tension. The concrete then should be made of sufficient thickness to take all of the compression. This will be accomplished by the use of the following formula:

$$t_c = 0.1 \times \frac{1}{42 - 0.06\,H} \times \frac{H^2}{D}$$

where t_c = thickness of concrete chimney wall.

Table II gives the results of calculating t_c by that method.

TABLE II

Height, Ft.	Outside Diameter at Base, Ft.					
	5	6	7	8	9	10
100	5.55	4.63	3.97	....	....	....
125	9.05	7.54	6.46	5.66	5.03	....
150	....	13.8	11.9	10.41	9.26	8.34
200	....	....	19.0	16.62	14.8	13.33
250	....	....	....	28.92	25.71	23.14

Foundation Base.—If an octagonal base is used, in order that there shall be no tension on the soil, we have the formula:

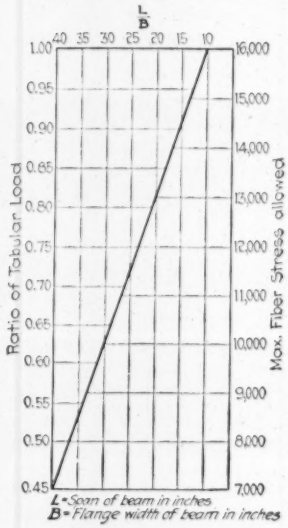
$$D_B \times W = 0.045 \times D \times H^2$$

where W = weight of entire chimney in tons.

The spacing of reinforcing bars should be made to conform to the best practice, and care given to have them close enough together to prevent cracking.

Diagram for Capacity of Unstayed Beams

In the accompanying diagram the reduction of bending strength of I-beams and channels with unstayed compression flange is represented graphically. The diagram plots the American Bridge Co. formula, according to which the allowable compression in the flange shall not exceed $19{,}000 - 300L/B$, in which L is the span of the beam in inches and B is the flange width in inches. The maximum ratio of length to flange width is 40. The formula is not intended to allow a greater fiber stress than 16,000 lb., so that the limits of the formula are L/B from 10 to 40. This diagram was prepared by N. H. Holmes, Chicago.



ALLOWABLE FLANGE STRESS IN UNSTAYED BEAMS

If some other formula for flange capacity is preferred to that used by the author it can easily be laid down on the diagram by plotting a number of computed values, two being sufficient for any straight-line formula. It is also possible to substitute other limiting values of unit-stress and unstayed flange length without affecting the application of the diagram.

Stadia System for Traverse Work

BY J. A. MCDONALD
Provincial Land Surveyor,
Hermanville, Prince Edward Island, Canada

THE fact that fewer men are required for a stadia party than for an ordinary transit party has led the Topographical Surveys Branch of the Canadian Department of the Interior, at Ottawa, to adopt the stadia system almost exclusively in its traverse work. In a combination of hydrographic and topographic work such as the traversing of lakes and other bodies of water, the party consists usually of a surveyor, transitman and two rodmen, with one or two boats. Such a traverse is made usually from one or more instrument stations at or near the shore.

There is an advantage in keeping one rodman on each side and surveying both sides at the same time, the rodmen following the shore in opposite directions until they meet at the far side. In general, however, the survey will be made on one side only, the front rodman traveling away from the surveyor and the rear rodman traveling towards him. The rear rodman having reached the surveyor and the front rodman having reached the next instrument station, the surveyor moves to the next station and sets up the instrument.

The rear rodman places his rod upon the previous station for orienting the transit, and the survey proceeds as before.

It is well to remember that when the sun is shining and the distance is great a rod cannot be read unless the sun is shining upon its face, so that only one of the rods can be used for measuring side shots, according to the direction of the sun. The rodman who is not giving side shots along the shore can take soundings from the boat and also gives side shots to stations on islands. When no instrument observation is taken, the instrument is oriented by means of the compass, or rather by the magnetic needle recording the azimuth of north deduced from previous readings or from astronomical observations taken from a magnetic map.

The Rodman's Duties

It is important for the rodman to understand the significance of holding the rod vertical and ascertaining if it is hidden also how to select a new instrument station. The face of the rod should be turned slightly toward the sun when by so doing the sun can be made to shine on the graduations. A system of signals should be arranged for directing the rodman to stop or to start or to inform him that the rod is hidden. Before the rodman leaves the instrument station it is well to indicate to him, as nearly as possible, where the next station is to be. It is more important that the surveyor himself act as front rodman, or at least be with him at instrument points or stations and have the transitman at the instrument. It is also well to read the three wires for both the front and rear instrument stations as a prevention against errors. When the instrument is but a few feet above the water it is not necessary to record vertical angles. When the inclination exceeds 2° the vertical angle should be recorded, and the proper correction applied to the distance read between instrument points; this is unnecessary also in side shots if the vertical angle of inclination is large.

Reading the Rod. For reading distances, set the lower wire on a division on the rod. Count the number of feet, tenths and hundredths to the upper wire and estimate the fraction. Distances read by means of the whole interval are twice as accurate as if read with the half intervals. The length between stations should always be measured with the whole interval. When the distance is less than 1,300 ft., or 20 chains, the readings with the half interval will have to be made at distances greater than 20 chains, as the limit of any 13-ft. rod is but 1,300 ft. with the whole interval reading and 2,600 ft. with the half interval.

When the sum of the readings of the half intervals equals the reading of the whole interval the check is significant. The constant of each instrument, for focal length of objective plus distance from objective to center of instrument is from one to two feet, and this must be added to the readings. In inclined sights the reductions of distance may be quickly made by means of the slide rule. When the difference between the starting and closing corners differs more than 5 per cent from the distance in an original survey, the error should be located by retracting with the stadia.

Plotting the Survey. A rough sketch of the survey should be made or plotted in the right hand page of the field book as the work proceeds, or at least before leaving the locality. Two books may be used, one being left in the office or camp while the other is in use on the survey. Make the plot first, at least, in pencil, preferably on paper ruled to a scale of 1,000 ft. to the inch. Commence plotting carefully the instrumental stations and work in pencil the north and south points of each station. Plot the side shots by means of the protractor. Then enter on the plan the soundings taken, if any, topographical features and other information that has been collected. The left hand page of the field book is for the notes; the right hand page for a sketch of the survey. Stations are designated by numbers and side shots by letters. In the first column of the left hand page enter the letter of the side shot or the number of the station sighted upon. The second column is for the distance read or estimated, the third for the bearing and the fourth for the vertical angle, the remainder of the page being for remarks.

At each instrument station enter in the notes the nature of the shore or rise of the ground from the water's edge, the depth of the water as determined from soundings, the estimated distance of the foot or top of the slope, topographical features, the nature of the ground, whether marshy, hilly or wooded, and particulars as to rock, iron or coal outcrop.

Although 2,600 ft. is the limit of the rod reading with 13-ft. rod, using it at half interval, distances greater than 2,600 ft. can be read across water by placing the rod on a high stump, thus lengthening the rod. The target then may be the field book covered by a white handkerchief held by the rodman on the stump. In this way shots up to 4,000 ft. have been read by the writer.

Diagram Aids Slope Determination in Hopper Design

By H. J. Adams
Sticht-Adams Co., Denver, Col.

In the building of hoppers, bins, bunkers, etc., the designer slopes the bottom so that the material handled slides out when released. Knowing the angle of repose of the material contained in the hopper, various sloping planes comprising the bottom are so inclined

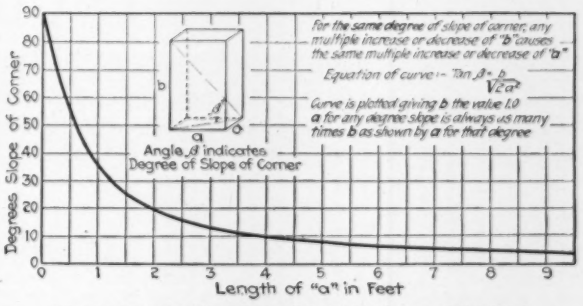

Degrees Slope of Corner
Length of "a" in Feet
Angle β indicates Degree of Slope of Corner
For the same degree of slope of corner, any multiple increase or decrease of "b" causes the same multiple increase or decrease of "a"
Equation of curve:- Tan β = b/√(2a)
Curve is plotted giving b the value 1.0 a for any degree slope is always as many times b as shown by a for that degree

DIAGRAM TO DETERMINE SLOPE OF CORNERS IN HOPPERS

that not only they, but the corners also, are freed from material when being emptied. The inclination of any two consecutive sides is always greater than that of the corner formed by their intersection. Therefore it is the slope of the corner which must equal or exceed the angle of repose of material handled.

In all probability the majority of designers resort to

the "cut-and-try" method to accomplish the desired result. It is a time-consuming method, to say the least.

As a simplification of the process, the author has found the accompanying curve of considerable aid. It applies only to hoppers or bins of rectangular shape, the bottoms of which are formed by four intersecting planes of equal slope. From this curve one can read for a certain degree of slope of a corner the vertical and horizontal distance through which the sloping line runs.

The equation of the curve is $\tan \beta = \frac{b}{\sqrt{2a^2}}$ in which β is the angle indicating degree of slope of corner: b is the vertical distance through which the sloping bottom is effective; a is the horizontal distance through which the slope of each bottom plane is effective. In plotting the curve, b is given the value 1. The completed curve shows at a glance the ratio of b to a at any point. Since b is always 1, a at 10 deg. is $4b$, at 5 deg. a is $8b$; at 22 deg. a is $1\frac{1}{2}b$; at 55 deg a is $\frac{1}{2}b$, and so on.

If a corner slope of 25 deg. is required for a certain material to be handled, we find immediately from the curve that a must be $1\frac{1}{2}b$ to secure the desired result.

Splitting Failure in a Wooden Truss

By H. K. Phelps
Los Gatos, Cal.

RECENTLY the sagging of a roof supported by shallow timber trusses brought to light an interesting case of truss failure in this city. The sketch herewith shows the general outline of the trusses, while Fig. 2 contains views of the middle point of the bottom chord

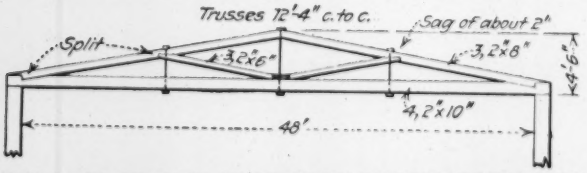


FIG. 1. DIMENSIONS OF SHALLOW WOODEN ROOF TRUSS

and the joint between top chord and strut, in one of the trusses. Two out of four trusses distorted so much as to have virtually failed, while the other two sagged a less amount but yet quite noticeably.

The dimensions of the structure are indicated by the photograph. The loads supported were a ceiling of metal lath and plaster and a roof covering of 1-in. sheathing covered with tar and gravel; the sheathing was carried on 2 x 6 fir purlins spaced 2 ft. on centers. The roof was built about four years ago, but failure was not noticed until this spring. It is not possible now to determine whether the trusses were designed by a technical man or were built according to the carpenter's own judgment, but the latter appears probable.

Probably the cause of failure was the defective bearing of the strut against the top chord, producing a wedge effect and splitting the top chord. There did not seem to be lateral displacement at any of the joints. Doubtless the extreme flatness of the trusses had something to do with the failure. In rebuilding the roof, trusses 10 ft. 6 in. high, with members of make-up similar to that found in the old trusses, were put in.

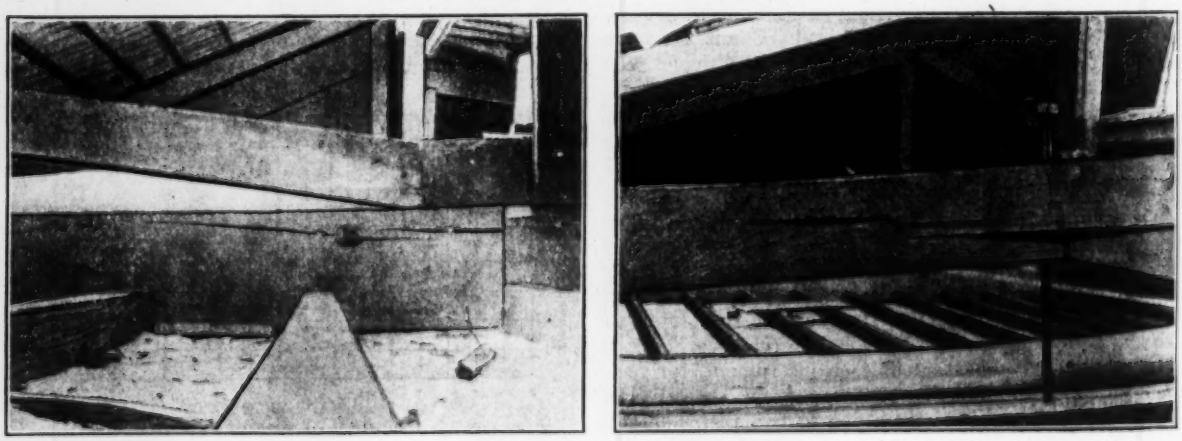


FIG. 2. JOINTS OF STRUT WITH BOTTOM CHORD AND TOP CHORD

A Group of Articles for

Highway Grades Determined by More Exact Methods

By Arthur W. Consoer
Consoer Engineering Co., Chicago

BECAUSE of the recognized value of grading in the development of highway systems to serve traffic needs, the question of the scientific establishment of grades in highway work becomes increasingly important. The actual mechanical process of grade running for the various types of improved roads is a subject that receives scant attention or none at all in the leading text and reference books on highway engineering. There are many points of vital importance to an engineer seeking to run a satisfactory and economical grade line, upon which no definite information is given.

In actual practice much of this work is performed in haphazard fashion and the full scientific possibilities of the subject are not developed. To keep down the cost per mile of completed plans the work is often done very hurriedly. There is sometimes a tendency to overlook obvious economies in the establishment of grades. In many public offices there is a tendency to judge engineers engaged in the work of running grades by the mileage of grade established daily.

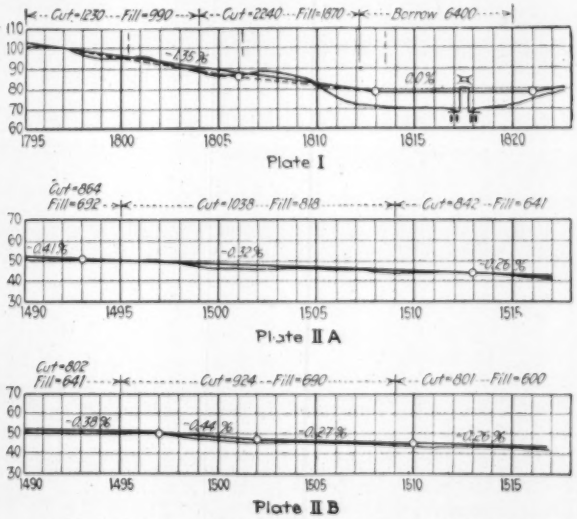
In many highway offices it is common practice for an engineer to run a mile or more of grade line in one day,

the "Average Engineer"

using the ordinary methods of measuring cross-sectional areas with the planimeter. The first apparently satisfactory grade line which balances cuts and fills is accepted as final, and no further trials are taken to determine whether or not there is another equally satisfactory grade which is more economical of earthwork. It is obvious to anyone who has made a study of drainage and grade economies that this hasty procedure is extremely wasteful from the standpoint of correct design for service, and because of the economic loss entailed in moving larger quantities of earth than are really necessary.

The following examples taken from actual practice will illustrate the importance of slowing up the work of grade running:

Attention is called to the erroneous placing of balance points in Plate I and also to the large amounts of cut, fill and borrow. A placing of balance points started on high level ground has been carried down into the depression, and much of the dirt is moving uphill for fill which should be moving down. The amount of earthwork is greatly increased by adhering to an absolute uniformity of grade instead of a practical uniformity. A grade such as is shown in dotted lines would have saved at least 1,000 cu.yd. of earthwork with no appreciable difference in drainage efficiency or riding qualities of the surface.



PROFILES SHOW COMMON ERRORS IN LOCATING HIGHWAY GRADES

The error in grade shown in Plates IIA and IIB is not as striking or as apparent as in the first example. However, it is an error which is extremely common even in the best conducted road offices. In Plate IIA a uniform grade of 0.32 per cent from station 1495 to station 1509 produces earthwork totals of 1,038 cu.yd. of cut and 818 cu.yd. of fill. A very slight change to the grade shown in Plate IIB reduces the earthwork to 924 cu.yd. of cut and 690 cu.yd. of fill at no sacrifice of drainage or riding qualities of the surface. The change in gradient from 0.44 per cent to 0.27 per cent when translated into more easily grasped figures means a change of about 2 in. per 100 ft. This slight change, unnoticeable to the driver of a vehicle over the finished surface, would represent a saving of over one hundred dollars in the cost of the grading of 1,400 feet.

In the writer's opinion the fundamental theory of economical grade which every engineer working on grade line should keep constantly before him is: that the most economical grade is one which comes as closely to balancing cuts and fills at each cross-section as is consistent with other necessary principles of design. Factors interfering with the ideal application of this principle are limiting grade, a certain desirable uniformity of grade, and drainage. All of these factors vary with the type of pavement and the character of the traffic to be expected after the road is open for travel. Except as thus modified the finished grade line should always be a graphical representation of the economical theory, and not a haphazard balancing of cut and fill.

The first step in running a grade line after the profiles and cross-sections have been plotted should consist of a thorough study of drainage conditions. The method of drainage, whether by tile or side ditches should be determined. After the culvert and bridge locations have been made and designs made for these waterway openings in the road, the correct grade elevations of the low points where fills are needed can be established. This having been done, trial grades should be run in both directions from the low points. The engineer can then determine whether the fill can be made within balance points with cut obtained by using the standard construction cross-section. If not the relative economies of widening and deepening the ditches and borrow should be figured, and the most economical selected.

To Spring a Groined Arch Between High Column and Low Walls

BY PERRY THOMPSON
Sanitary Engineer, Yonkers, N. Y.

IN COVERING two existing open sand-water filters at Yonkers, N. Y., it was necessary either to spring the proposed groined arch roof down to a cut-down level of the disintegrated side wall or to build that wall up so as to provide a symmetrical arch with abutments at the same elevation. The former method was resorted to, after an analysis described below.

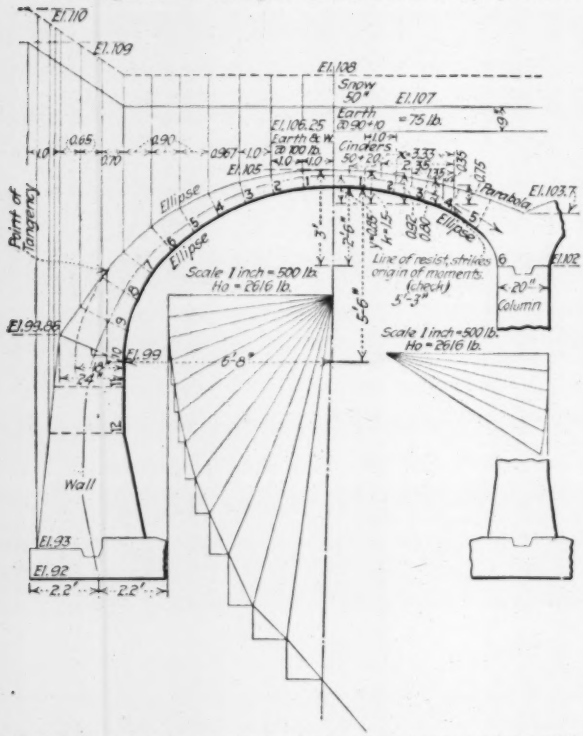
It had previously been decided to use cinders averaging about 2.5 ft. deep for the bulk of the filling over the vaulting because of their cheapness, availability, lightness and good drainage qualities. Over the cinders 9 in. of soil or loam was to be placed, and it was assumed that 12 in. of wet, compact snow represented the probable maximum load from that source. Concrete was taken to weigh 145 lb., cinders (wet) 70 lb., earth (wet) 100 lb. and saturated snow 50 lb., all per cu.ft.

It was recognized at once by mere inspection that the crown should be nearer the columns than the wall, but it was not till after a trial force diagram was drawn and the line of resistance was shown to pass out at the extrados that it was found necessary to load the arch toward the wall entirely with earth; even the bank, which protects the filters from flood water in the river, was moved over till the toe of the slope was over the inner face of the wall.

The voussoir method and least crown thrust theory were employed and the arches divided into a convenient number of imaginary blocks. The origin of moments was taken at the lower edge of the middle third of the fourth "joint" to the right of the assumed crown. A table of vertical and horizontal forces was prepared and their moments about the assumed origin computed. This gave an estimated crown thrust of 2,616 lb. per ft. of arch, which thrust was then laid off to a scale of

1 in. to 500 lb. and a force diagram constructed and carried just far enough to ascertain whether the line of resistance would pass through the origin of moments. This proving to be the case, and the unit stress on the concrete not being excessive, the crown thrust was employed to begin a new force diagram laid off in the opposite direction for use in connection with the portion of the arch toward the wall.

The diagram is thought to be sufficiently plain to



GRAPHIC ANALYSIS OF ECCENTRIC GROINED ARCH ROOF

require no explanation. The resultant is shown passing through the arch at all points within the middle third and finally passing through the lowest block practically in the center and slightly inclined inward where its horizontal component is amply taken care of by the floor, while its vertical component of less than one ton per square foot will be easily resisted by hard clay stratified with sand.

But this is not all of the problem. The lines laid down on paper had to be reproduced in the field in the shape of forms, to insure accuracy in which the specifications called for full-size drawings to be furnished to the contractor. This could be accomplished in two ways: First, by the use of foci nearly 14.5 ft. apart (for the longest span) laid off on a floor, and a very flexible line over 18 ft. long that would not stretch; second, by the use of abscissas and ordinates laid off on heavy brown drawing paper on two large drafting tables.

The latter method proved more satisfactory; furthermore, the co-ordinates could be used again on the work to check up forms and centers as constructed and as set, while the string and foci method would be very troublesome, if not impossible. It was found that for points about 6 in. apart on the curve the ordinates must be figured to $\frac{1}{16}$ in., and the + and — signs used virtually made $\frac{1}{32}$ in., giving a smooth curve. Drawings on a scale of 1 in. to 1 ft. for field use were then made.

A Group of Articles for

Effect of Curvature Upon Flow in Open Channels

By Harrison P. Eddy
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

IT IS a well recognized fact that changes of direction in a conduit cause resistance to flow and corresponding loss of head. It is also appreciated that the amount of such loss is influenced by the velocity of flow, by the sharpness of the deflection or radius of curvature, and by the occurrence of reversals in the direction of curvature. The length of the curve is also generally believed to be a factor, although Ivan E. Houk (Technical Reports, Part IV, of the Miami Conservancy District, entitled "Calculation of Flow in Open Channels") states that "the actual length of the curve probably does not have much effect on the amount of the retardation due to their presence. The increased roughness is probably brought about by the changes in velocity distribution and water surface level necessary when the flow enters or leaves the curved stretches rather than in the continued flow in a given curve." While there may be greater disturbance at the ends of the curves, due to readjustment of velocity distribution as stated, there still remains the loss of the energy required to constantly deflect the mass of water throughout the length of the curve, and it is probable that the curve lengths should be taken into account in making allowance for curvature.

Data relating to losses due to curvature in closed pipes up to 30 in. in diameter are fairly complete for 90 deg. changes in direction and short radii and moderate velocities, but are very fragmentary and unsatisfactory for other conditions, and very little information relative to the losses due to curvature in open channels is available. The application to open channels of data obtained on closed pipes under pressure is open to error because the conditions differ so widely. pipes are usually of small size as compared to open channels. In pipes, the area and hydraulic radius remain constant from point to point and conditions of uniform flow exist; in open channels, unless the slope of the bottom happens to be at all points parallel to that of the water surface—a condition that practically never occurs except in long tangents—the flow is variable; the area of the section, the velocity and hyraulic radius are constantly changing. If the bottom has a uniform slope, the resistance due to a curve in alignment will cause the water to back up and produce a "back water curve" in the lower portion of the tangent above. In measuring the hydraulic slope in the tangent, the effect of this backwater must be avoided, since the backing up at the beginning of the curve will result in greater depth, less velocity, etc., than in the undisturbed portion of the tangent, conditions for which the hydraulic slope will be lessened.

Where the curve joins the tangent below, or changes to a curve of different radius, there will again occur a backwater curve (either up or down), so that the determination of the true slope due to curvature is not possible from observations at the beginning and end of the curve alone. This fact has not usually been recognized.

The earliest attempt to deduce an expression for the

the "Average Engineer"

loss of head due to curvature in open channels is probably that of Humphreys and Abbot, who published in 1861 a report upon their researches on the Mississippi River. Their results, as given in Church's "Hydraulics," are expressed by the equation

$$h_c = v^2/536 - 6A/\pi,$$

where h_c represents the loss due to curvature through an angle of deflection of A expressed in circular measure. Since this formula was derived for conditions of great width of channel and large radius of curvature, its application to comparatively small channels and bends of relatively small radius is at least questionable. More recent investigations also tend to discredit the investigations of Humphreys and Abbot.

Formulas for loss due to curvature have been derived by Markmann (1910), Weston E. Fuller (1913), and Morreell (1916). Markmann's formula was based wholly upon a theoretical study, and has not been supported by experiments; Morreell's and Fuller's expressions have been derived from the results of experiments upon closed pipes, all of small size, especially as compared with stream channels; and none of them are believed to be applicable to such conditions as exist in the stream channels either natural or improved.

E. G. Hopson reports figures of observed losses due to curves in open channels in an article entitled "Gagings in the Concrete Conduit of the Umatilla Project," in *Engineering Record*, Oct. 21, 1911. These were all made with velocities of approximately 7 ft. per second, and, therefore, do not furnish a basis for estimating change of resistance with change of velocity.

Computations of probable conditions of flow, so far as can be determined from the published data, indicate the apparent effect of the curves upon the value of the roughness coefficient n in the Kutter formula. The results are included in the accompanying table. The range in values is caused by variations in certain assumptions made necessary by the absence of detail in the published data.

Bulletin No. 194, U. S. Department of Agriculture (Also in Table 112, King's "Handbook of Hydraulics"), contains notes upon the values of n found in experiments upon Sulphur Creek Wasteway, Ridenbaugh Canal, and North Canal. Although the lack of detail in the data introduces considerable uncertainty, the data of such cases may be used for rough computations of the effect of curvature upon the value of n and the results of such calculations are included in the accompanying table.

Except in the first instances, the velocities are seen to be relatively low; and it is to be expected that higher velocities would give greater losses on the curves. The Sulphur Creek Wasteway, although having a high velocity, has a curve of very long radius, which accounts for the relatively low increase in the value of n in this case.

Mr. Houk, in Part IV, Technical Reports of the Miami Conservancy District, previously referred to, makes the very general statement concerning allowance for curvature that: "The Value of 0.025, which is applicable for a smooth uniform straight channel in gravel, free from vegetation or other obstructions—may be increased 10 per cent or more by curvature in alignment."

Conclusion—The available information is so fragmentary and indefinite that it is impossible to draw entirely satisfactory conclusions, but it appears probable that in artificial channels for which the coefficient n in Kutter's formula would not exceed about 0.025 for a straight channel, an addition of from 0.003 to 0.005 should be made to the coefficient for sections in which the amount of curvature is considerable.

TABLE I. EFFECT OF CURVATURE UPON VALUE OF "n" CALCULATED FROM EXPERIMENTAL DATA

Channel All Concrete Lined	Value of "n": On Tangent Alone	Value of "n": On Curves Alone (Computed)	Value of "n": Addition for Curvature	Radii of Curves, Ft.	Velocity of Flow, Ft. per Sec.
Umatilla conduit	0.0135 to 0.0137	0.0176 to 0.0184	0.0049 to 0.0039	50	7
		0.0162 to 0.0169	0.0025 to 0.0034	100	7
		0.0160 to 0.0173	0.0023 to 0.0038	250	7
Sulphur Creek Wasteway	0.0108	0.0140	0.0032	2,865	20
Ridenbaugh Canal	0.0121	0.0145	0.0024	955	3.7
North Canal, Central Oregon Irrigation Co.	0.0177	0.0202	0.0025	410	3.0
	0.0176	0.0205	0.0029	and	2.9
	0.0192	0.0222	0.0030	383	2.1

There seems to be at least a probability that the frictional loss due to curvature varies with the radius of curvature and with the velocity of flow and that when more complete information is available it may be possible to make proper allowance for these factors. At present, however, there does not seem to be any more satisfactory method of providing for the effect of curvature than by increasing the coefficient n, as indicated above.

Diagram for Final Adjustment of Grade Line Location

By S. E. Redd

Engineer, Greenlee County Highway Commission, Morenci, Ariz.

BOTH IN the location of railroads and highways there has always been great difficulty in securing a location that was *exactly* right in regard to economy and good standards. It is a common thought among most conservative engineers that no line is ever located exactly right, but that the best locations are only very close approximations; the more skillful the engineer making the location, the more approximately correct the location will be. One of the principal difficulties in location is to get the quantities of excavation and embankment as small as possible, and also to balance each other as closely as possible.

The following is offered as a method for studying a preliminary location very closely and easily, and the writer has found it of great assistance in laying his location close to the ground and in balancing the quantities. After the usual maps, profiles and cross-sections have been made and calculated the following diagram will be of assistance: Take some cross-section or profile paper; use the same horizontal scale that is used on the regular profile, but with ordinates at each station such that each ordinate will represent the area of the cross-section at that station. In most highways there

will generally be two ordinates at each station, one for the cross-section of the excavation and the other for cross-section of the embankment. There will be developed two lines, one for the excavation and one for the embankment, which should be represented differently, say the excavation by a solid line and the embankment by a dotted line. Both lines had best be drawn on the same side of the base from which the ordinates are measured.

When such a diagram of a section of line has been drawn one can immediately see that it has the following properties: The difference between the ordinates at any station will be the difference between the sectional areas of the excavation and embankment at that station. The area contained between the ordinates of two stations and one of the lines and the base, from which the ordinates are drawn, will be the volume of excavation or embankment, according to which line was taken. The area between the lines of excavation and embankment and the two ordinates of two stations will be the difference between the volume of the excavation and embankment between those stations.

The object to be derived from the study of such a diagram will be to bring the two lines of excavation and embankment as close together as possible without injuring the alignment, also, where it is impossible to bring these lines together, to make the areas showing excavations as closely equal to the areas showing embankment as possible. This object, of course, is always the object of any locating engineer, but the writer believes that a diagram as above shows the faults of a location much more plainly than any other method that he has ever tried. The ease and speed with which such a diagram is drawn can be seen as soon as one tries it.

The ordinary mass diagram is very convenient in studying the balance of cuts and fills in heavy through work as usually found in railroad work, but it does not furnish the information so easily on side-hill work such as found in highway work.

The writer usually uses this diagram after cross-sections have been first taken. It is usually at this point that certain unforeseen features of the line cause excessive work at certain points. This diagram not only shows the points but aids in the study of improvement.

Fresnos Keep Sand Drifts Off Plank Road

The shifting sand dunes in Imperial County, Cal., have made it necessary for the California Highway Commission to provide means for keeping the plank road built through that territory free from sand drifts. The drifts frequently form in depths of 5 to 6 ft. and range to 100 ft. in length. Usually one man and team are assigned to the maintenance and inspection work on the planked section, which is 5½ miles long. During periods when the wind blows continuously, more teams have to be added to keep the road clear. The sand is scraped off the road with fresnos onto the side away from the direction in which the prevailing winds blow.

A Group of Articles for

Tables for Computing Irregular Street Intersections

By R. D. Gladding

Gladding & Morrison, Municipal Engineers, Wilson, N. C.

TABLES for computing areas and radii of irregular street intersections can be used as a refinement of the method described by the writer in *Engineering News-Record*, Aug. 9, 1917, p. 265, where graphs were used. The problem involves the computation of the area included by the tangents and the arc of a circle, without the necessity of measuring the angle of intersection. All the data needed, therefore, can be taken by using the tape only.

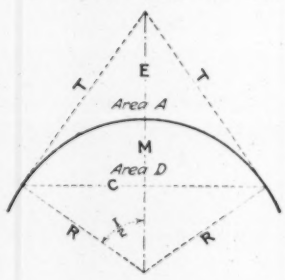


TABLE I. RADIUS OF CIRCLE

$$R = \frac{1 - 4B^2}{4B} T = ST;\ R = \frac{4B^2 + 1}{8B} C = S'C;\ B = \frac{E}{2T} = \frac{M}{C}$$

B		0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	
0.0		∞	25.0	12.5	8.30	6.21	4.95	4.11	3.50	3.05	2.69	S
		∞	12.5	6.25	4.17	3.13	2.53	2.12	1.82	1.60	1.44	S′
0.1		2.40	2.16	1.94	1.79	1.65	1.51	1.40	1.30	1.21	1.13	S
		1.30	1.19	1.10	1.03	0.962	0.909	0.859	0.822	0.785	0.753	S′
0.2		1.05	0.980	0.917	0.857	0.802	0.750	0.702	0.657	0.613	0.572	S
		0.725	0.699	0.679	0.659	0.640	0.625	0.611	0.598	0.586	0.576	S′
0.3		0.533	0.497	0.461	0.428	0.395	0.364	0.335	0.306	0.278	0.251	S
		0.567	0.558	0.551	0.543	0.538	0.532	0.527	0.523	0.519	0.516	S′
0.4		0.225	0.200	0.175	0.151	0.128	0.106	0.0835	0.0620	0.0408	0.0202	S
		0.513	0.510	0.508	0.507	0.505	0.503	0.502	0.501	0.500	0.500	S′
0.5		0.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	S
		0.500	.....	.....	.....	.....	.....	.....	.....	.....	.....	S′

TABLE II. VALUES OF $\frac{\text{"I"}}{2}$ FOR "B"

B	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0	2.29	4.57	6.87	9.14	11.39	13.68	15.96	18.18	20.41
0.1	22.61	24.84	27.00	29.15	31.27	33.40	35.48	37.56	39.60	41.61
0.2	43.59	45.57	47.51	49.38	51.28	53.13	54.93	56.73	58.50	60.21
0.3	61.89	63.58	65.24	66.86	68.43	60.98	71.50	73.00	74.46	75.91
0.4	77.31	78.70	80.05	81.39	82.69	83.97	85.22	86.45	87.66	88.84
0.5	90.00	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE III. AREA "D" FOR RADIUS = 1

I/2	0	1	2	3	4	5	6	7	8	9	Diff.
0	0.000	0.01745	0.03491	0.05236	0.06981	0.08727	0.1047	0.1222	0.1396	0.1571	0.01745
10	0.1745	0.1920	0.2094	0.2269	0.2443	0.2618	0.2792	0.2967	0.3143	0.3316	0.01745
20	0.3491	0.3665	0.3840	0.4014	0.4189	0.4363	0.4538	0.4712	0.4887	0.5061	0.01745
30	0.5236	0.5410	0.5585	0.5759	0.5934	0.6109	0.6283	0.6458	0.6632	0.6807	0.01745
40	0.6981	0.7156	0.7330	0.7505	0.7679	0.7854	0.8038	0.8203	0.8377	0.8552	0.01745
50	0.8727	0.8901	0.9076	0.9250	0.9425	0.9599	0.9774	0.9948	1.012	1.030	0.01745
60	1.047	1.605	1.082	1.100	1.117	1.134	1.152	1.169	1.187	1.204	0.01745
70	1.221	1.240	1.257	1.274	1.292	1.309	1.326	1.344	1.361	1.379	0.01745
80	1.396	1.414	1.431	1.449	1.466	1.484	1.501	1.518	1.536	1.553	0.01745
90	1.571	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.01745

The underlying principle is that the ratio of the external secant to the tangent equals the ratio of the versed sine to the sine. This allows one table to give the values needed in the problem using both these ratios.

Usually, in the field, only one set of distances can be measured, either E and T or M and C. The illustrative problem supposes that both sets could be measured. In the problem, an arc was drawn and the distances scaled.

The ratio B equals $E/2T$ equals M/C. From this ratio, using the tables, the factors S and S' may be multiplied by T or C respectively to obtain the radius, and the value of $I/2$ can be easily found.

Example:

$B = 9.15/31.4 = .291$;

$B = 4.49/15.6 = .288$ (average, .290);

From Table I, $S = .572$, and $S' = .576$;

the "Average Engineer"

Radius = .572 × 15.7 = 8.97;
Radius = .576 × 15.6 = 8.98 (average, 8.98);
(Area A) + (Area D) = 8.98 × 15.7 = 141.0;
With value of B given, from Table II, I/2 = 60.21 deg.
From Table III, $D = 1.047 + 0.21 \times 0.0175$
$= 1.051$;
(Area D) = $1.051 \times 8.98^2 = 84.8$;
Therefore, $A = 56.2$.

This method has been found very accurate for determining the area, and does not require much time in the field and office. The tables may be used for other computations of the circle, as readily suggested by the diagram.

Some Notes on Field Methods in Running Land Lines

BY F. ERNEST BRACKETT
Civil and Mining Engineer, Cumberland, Md.

FOR TRANSIT WORK on land lines, etc., such as the country practitioner with a "scrub" corps is likely to encounter, the following notes may be useful. They constitute a simple and well-tried method of transit survey in connection with the old compass work in the field.

In such surveys the beginning point and probably variation of the compass will have been determined. The most convenient method of reading the angles is by the continuous vernier system—magnetic north equals zero. The first line of the transit survey will often be a random back sight on the beginning to avoid a fence on the line. The survey then proceeds as closely as practical to the old courses and land marks. The legal location of the land line where these latter differ is of course a matter of local law and custom; but the engineer is constantly required to keep in touch with the relations between his transit line, the old compass courses, and the existing land marks. On large or important work this is usually worked out in the office after the survey is made, but in the class of work referred to it is often advisable that it be done in the field while all interested are present.

To pass a line around a tree or other obstacle a very convenient method is the use of a very obtuse isosceles triangle. Thus, in Fig. 1, to establish a point C on the line XA; set B at random, deflect left at B twice the right deflection at A, and make BC equal AB. Or if inconvenient to make the legs equal: compute the offset bB or measure it with a hand tape after setting stake B and before turning the deflection, set up at B and turn the telescope to a line parallel to XA, now with the hand tape lay off the offset cC equals bB and drive C at any desired point on the line XA extended. The azimuth of BC may then be read and recorded.

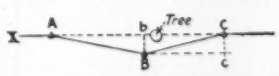


FIG. 1. LINE PASSED AROUND SINGLE OBSTACLE

Often, however, in the woods obstacles are so numerous and tedious for a small corps to remove that immediate return to the original line is time lost. In that case the plus and minus offsets may be carried ahead on the notebook indefinitely and a stake set on the original line whenever required. As the angles from the original line are all small, the plus to a stake so set or its total distance from the beginning, may be considered equal to the sum of the actual lines run. Thus the terminal stake of any course and distance may be set at once. In many other cases the marked corner will be found at some point more or less off the line originally assumed and a correction in variation

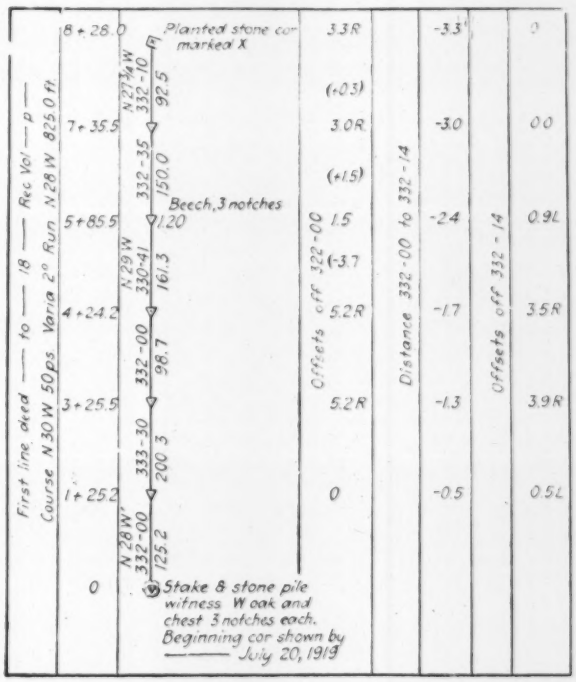


FIG. 2. FIELD NOTES AND COMPUTATIONS FOR OFFSET LINE ENCOUNTERING RANDOM OBSTACLES

of the compass made. The notes for a survey of this kind may be kept as in Fig. 2.

In Fig. 2, two points forming the terminals of a random survey which closely approximates a straight line must be joined by an accurate line. The correction to be applied to the azimuth of the assumed line is easily computed from the final offset and the total distance. Thus, in the notes, the assumed line is 332-00; the final offset, or algebraic sum of the deviations of each line of the random survey, is 3.3 ft., dividing this by the total distance, 828 ft., to find the sine or tangent (approximately equal) the correction is found to be 14 minutes to the right; the required azimuth is therefore 332-14.

The offset of all existing stakes from the new line may now be computed in the same manner as they were from the assumed line. Otherwise the surveyor may proceed as follows: By simple proportion on the slide rule, compute the distance between the new and old lines at each plus, and correct the offsets formerly arrived at by this amount. This method is shown to the right in the notes given. The position of the true line can now be readily marked.

It might be well to remark here that where a random line of the kind described consists of a number of equal courses the average of the azimuths is (approximately) equal to the azimuth of a line drawn between the terminals. Where they are not equal the weight of each angle in the average is proportional to the length of the course. The first of these conditions

rarely occurs and the second is too tedious to be of much practical use if accurately carried out. The point to be noted, however, is that both furnish a ready means of determining an approximate azimuth. Thus the actual average from the notes given is 332-09—an error amounting to only 1.2 ft. in the whole length of the line. Or the process might be made more accurate by assuming 100 ft. as the unit weight in the rough average. This unit weight would be given the first, third and sixth courses; that is, the azimuths of these lines would appear but once in the summation. The azimuth of the second course would be multiplied by two, while those of the fourth and fifth courses multiplied by, say, one and one-half. The total sum thus arrived at (2,658-04) is then divided by the sum of the weights (eight). The result (332-15) in this case is only one minute in error.

Method Saves Time

The above methods often save much time in the field where the closing line in a circuit must be computed by latitudes and departures. It frequently happens both on the surface and underground, that the circuit really consists of a few long courses although the actual transit line consists of many short ones deviating only a few degrees at most from the main directions. By consolidating these short courses in groups the length of the traverse table is often very much shortened. Moreover, since the ratios of the sum of the random lines to the true length between terminals in each of the groups are about equal, the error in assuming the length of the line between terminals equal to the above sum has very slight influence on the accuracy of the azimuth of the closing line determined on that basis.

This method may at first seem to involve almost as much work as the full traverse but it will be observed that the cosine calculation on random courses is avoided and that slide rule work becomes more convenient since small offsets are principally involved. Besides that the computation is certainly less exacting on the mind and less liable to material error because any great error in computing the major courses is generally apparent on direct comparison with the notes.

Ship Concrete in Germany

German engineers are studying concrete for ships with a view to getting a light, strong and impermeable material. As a result some experimenters are recommending adding to portland cement 10 to 25 per cent pulverized calcined limestone and 20 to 35 per cent of a pulverized silicate of magnesia, preferably white talcum, rich in silicates, and containing no chlorides. To this carefully prepared mixture some of the well-known porous ingredients are added, and then the substance is stored in a dry and airy place. Thereafter it is used for preparing the concrete in the same way as ordinary cement would be used, but in a richer proportion. The concrete obtained therefrom, by casting or ramming, is light, waterproof, elastic, acid-proof and tough, is reported to possess the good qualities of concrete for shipbuilding purposes in a higher degree than concrete made of pure portland cement. A great deal of experimenting is going on both in Germany and Austria in concrete ships and barges, particularly the latter for use on the inland waterway systems.

A Group of Articles for

Concrete T-Beam Diagram Permits Direct Designing and Checking

By A. V. Karpof and V. T. Givotovsky
Reinforced Concrete Engineers, Standard Arch Co., New York City

MOST diagrams for the design of reinforced-concrete beams only solve part of the problem and require considerable slide-rule or other computation. The writers have devised several diagrams which permit direct designing and checking and present herewith one of them—a chart for reinforced-concrete T-beams. It is worked out for concrete stress $f_c = 650$ lb. per square inch, steel stress, f_s=16,000 and according to the formulas of the 1916 Joint Committee report. Its use may be illustrated by the following examples:

Example 1

Given $M = 300{,}000$ ft. lb.
$V = 30{,}000$ lb.
$t = 6$ in.
$b = 6$ ft.

To find effective depth "d."—Find on the axis of moments the point corresponding to $M = 300{,}000$ ft. lb. then project vertically up until the vertical intersects the ray $b = 6$ ft. From this point of intersection project horizontally to the left until the horizontal intersects the vertical drawn from the point corresponding to $t = 6$ in. This intersection from interpolation between curves of d gives $d = 22.3$, say 22 in.

To find steel area, "A_s".—Find on the axis of moments the point corresponding to $M = 300{,}000$ ft. lb. then project vertically down until the vertical intersects the ray $d = 22$ in. Then project horizontally to left and on the axis of steel area the reinforcement is found to be $A_s = 11.36$ sq.in.

To find width of stem, "b'".—Assume unit shear must not exceed 120 lb. per square inch. Find on the scale of shearing force the point corresponding to $V = 30{,}000$ lb. then project vertically until the vertical intersects the ray $d = 22$ in. From this point of intersection project horizontally to the left until the horizontal intersects the vertical drawn from the corresponding point $V = 120$. This intersection from interpolation between rays of b' gives $b' = 12.5$ in.

To find perimeter of rods, "E_o".—Assume that rods are to be deformed. Find on the scale of shearing force the point corresponding to $V = 30{,}000$ lb. Project vertically until the vertical intersects the ray $d = 22$ in. Then project horizontally to the right and the perimeter of rods is found to be $E_o = 14$ in. on the deformed rods perimeter scale. If the rods would have been plain the perimeter required would have been found on the plain rods perimeter scale, and would have been $E_o = 16.8$ in.

Had the d and b' just found been inconvenient to use from an architectural or other standpoint adjustment could be easily made on the diagram and new values of d, b; A_s and E_o found by changing the unit shear and the width of flange.

Example 2

Given $M = 200{,}000$ ft. lb.
$V = 25{,}000$ lb.
$d = 30$ in.
$t = 5$ in.
$v = 60$ lb. per sq.in.

To find width of flange "b."—Find on the axis of thickness of slab the point corresponding to $t = 5$ in. Project vertically up until the vertical intersects the curve $d = 30$ in. Then project horizontally to the right until the horizontal intersects the vertical drawn from the point corresponding to $M = 200{,}000$ ft. lb. This intersection from interpolation between rays of b gives $b = 2.83$ ft. The steel area, A_s, width of stem, b', and perimeter of rods E_o are found in the same way as in example 1 and equal

$A_s = 5.6$ sq.in.
$b' = 15.5$ in.
deformed $E_o = 9$ in.

the "Average Engineer"

EXAMPLE 3

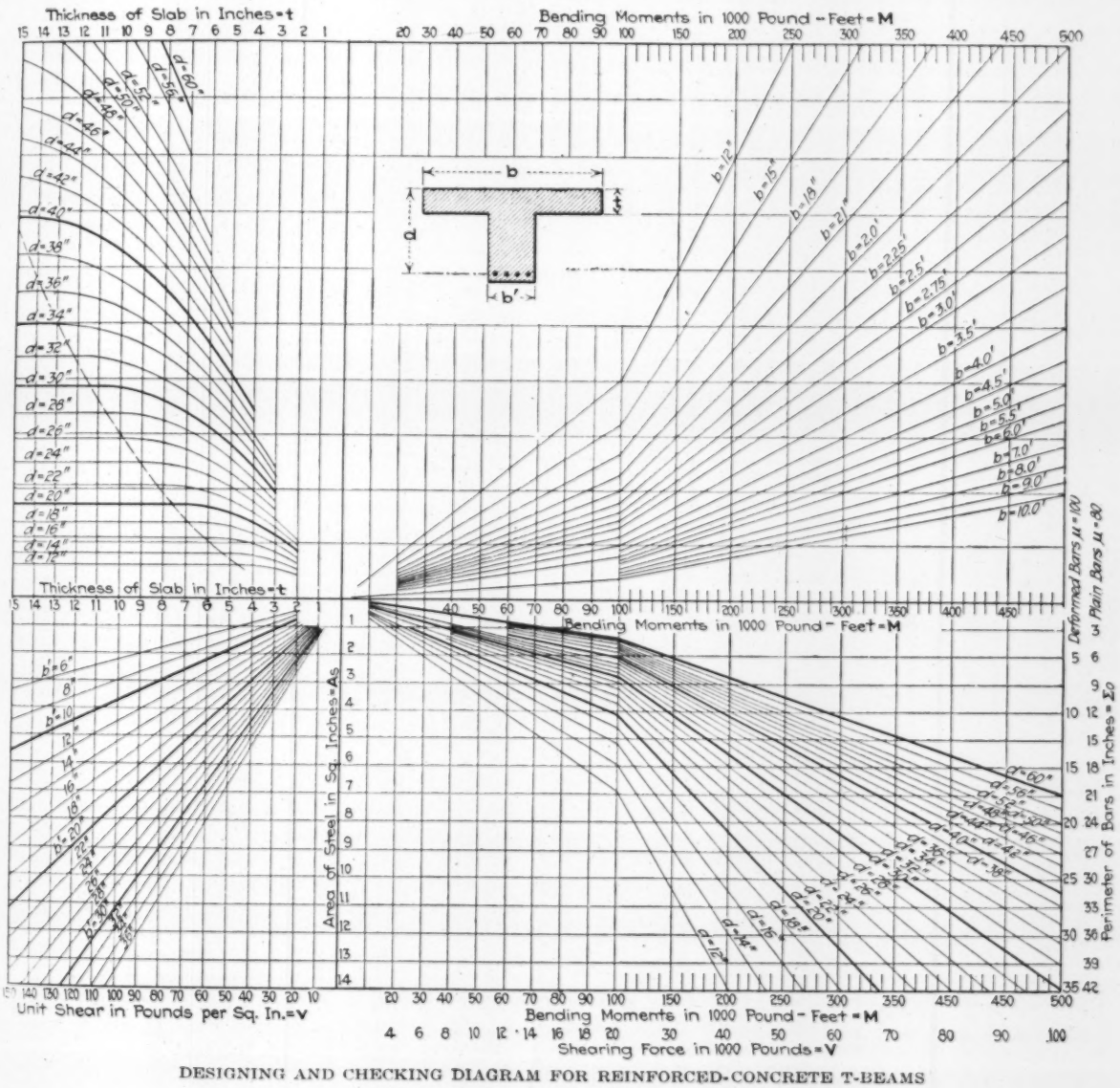
Given $M = 80{,}000$ ft. lb.
$V = 12{,}000$ lb.
$b = 2$ ft.
$d = 20$ in.
$b = 12$ in.

To find "t." — Find on the axis of moments the point corresponding to $M = 80{,}000$ ft. lb. Project vertically up until the vertical intersects the ray $b = 2.0$ ft. From this point of intersection project horizontally to the left until the horizontal intersects the curve $d = 20$ in. Then project down vertically from the point of intersection just found. The thickness of slab is found on the intersection of last drawn vertical and the axis of slab thickness to be $t = 5.3$ in.

To find unit shear, "V." — Find on the scale of shearing force V the point corresponding to $V = 12{,}000$ lb. Project vertically until the vertical intersects the ray $d = 20$ in. From this point of intersection project horizontally to left hand corner of the diagram until it intersects the ray $b' = 12$ in. Then project vertically from the point of intersection just found. The unit shear is found at the point of intersection of the last drawn vertical and the scale of unit shear to be $V = 55$. The steel area and perimeter of rods are found in same way as in example 1, and are equal to $A_s = 3.35$ sq.in.; deformed $E_o = 6.5$ in.

The dotted curve in the upper left hand corner of the diagram shows the transference of the neutral axis from the stem of T-beam into the flange when the beam must be designed as a rectangular beam and further increase in thickness of the slab will not result in any increase in moment. Therefore, beginning at the left of the dotted line the curves of effective depths of d transform themselves into straight horizontal lines.

Note that the scale of moments from 0 to 100,000 ft. lb. is larger than the scale of moments from 10,000 ft. lb. to 500,000 ft. lb. and that the scale of total shear from 0 to 20,000 lb. is larger than from 20,000 to 100,000 lb.


Thickness of Slab in Inches=t
Bending Moments in 1000 Pound-Feet=M
Thickness of Slab in Inches=t
Bending Moments in 1000 Pound-Feet=M
Area of Steel in Sq. Inches=As
Deformed Bars μ=100
Plain Bars μ=80
Perimeter of Bars in Inches=Σo
Unit Shear in Pounds per Sq. In.=v
Bending Moments in 1000 Pound-Feet=M
Shearing Force in 1000 Pounds=V

DESIGNING AND CHECKING DIAGRAM FOR REINFORCED-CONCRETE T-BEAMS

Detours Form Part of Service-to-Traffic Policy

Wayne County (Mich.) Commission Provides Many Temporary Routes—Some at River Crossings

By Edward N. Hines
Chairman, Board of County Road Commissioners, Wayne County, Mich.

THE Board of County Road Commissioners of Wayne County, Mich., is not merely building so many miles of concrete road annually, but is building and maintaining a transportation system. In order that the public may receive the greatest benefit from the unrestricted use of this system it is desirable that good detours be provided, particularly along main highways, when a road is being built or is closed from any cause. Providing detours around a road is a simple matter except where there are rivers or streams to cross. In cases of the latter type the commission has shown considerable initiative and ingenuity.

On the Dix road crossing the River Rouge there was built in 1912 a Strauss heel-trunnion bascule bridge, the movable leaf of which is 112 ft. long, the fixed span or A-frame 30 ft. long, and the clear width of the roadway 18 ft. The clear channel secured with the bridge in open position is 100 ft. wide.

The widening and deepening of the channel by the War Department necessitated the replacement of the foundations under this bridge. During the work of reconstruction traffic was maintained with only one stoppage of about 24 hr. from the beginning of the work in March until Sept. 1, 1920. Traffic was again stopped until Sept. 9 while sheet-piling was being driven under the bridge. On Sept. 22 the bridge was again closed to highway traffic and was not permanently reopened until Nov. 8.

Detours at Bridges

On the Plymouth-Northville road the commission began construction of a bridge 1 mile south of Northville, replacing an old township truss bridge which had been in service 35 years, and was designed to carry a 6-ton moving load. The old bridge is on a bad curve and it was necessary to build the new bridge on a new right-of-way, straighten the road and take care of traffic during construction, as shown in Fig. 1.

The new bridge is a reinforced-concrete, T-beam and slab structure consisting of two spans each 42 ft. long having a clear roadway of 24 ft. in width and designed to carry a 24-ton moving load. This bridge is now open to traffic.

Another detour on the Plymouth-Northville road which is being maintained for the convenience of traffic is at the new bridge being constructed at the Plymouth village limits. The existing steel bridge was skidded bodily to one side onto temporary foundations which had been previously constructed to receive it. A detour road (Fig. 2) was built in the meantime so that the only delay to highway traffic was of less than an hour's duration while the bridge was being moved. With the spring thaw the detour roadway softened up to such an extent that the heavy highway traffic created deep ruts and became mired at times. The commission provided a team of horses to tow the traffic through when necessary and also filled the ruts with large pebbles, dragging the road at convenient intervals, so that in a short time the detour was again passable.

On Gratiot road where the city of Detroit found it necessary to cut an open trench through a concrete road, because tunneling was prevented by quicksand, a plank road detour (Fig. 3) was constructed and maintained as a convenience to traffic.

On the Seven-Mile road, east of Woodward, a macadam road (Fig. 4) was built as a detour to avoid a big sewer job being constructed by the city of Detroit.

Plank Road Built

On Fort St., where the board is building a large bascule bridge over the River Rouge (Fig. 5) a concrete road was constructed as a detour over private property to the drawbridge owned and operated by the Detroit United Railway. A plank roadway was built between the tracks and traffic carried through onto Fort St. in the village of Oakwood. With the detour constructed the old bridge on Fort St. could be removed and work started on the new structure.

The board has also provided a substantial detour on Jefferson Ave. and the River Rouge, where a large bascule bridge is under construction. A location for a temporary bridge was selected about 200 ft. up-stream from the old bridge and right of way for a temporary road to this bridge from Jefferson Ave. was procured.

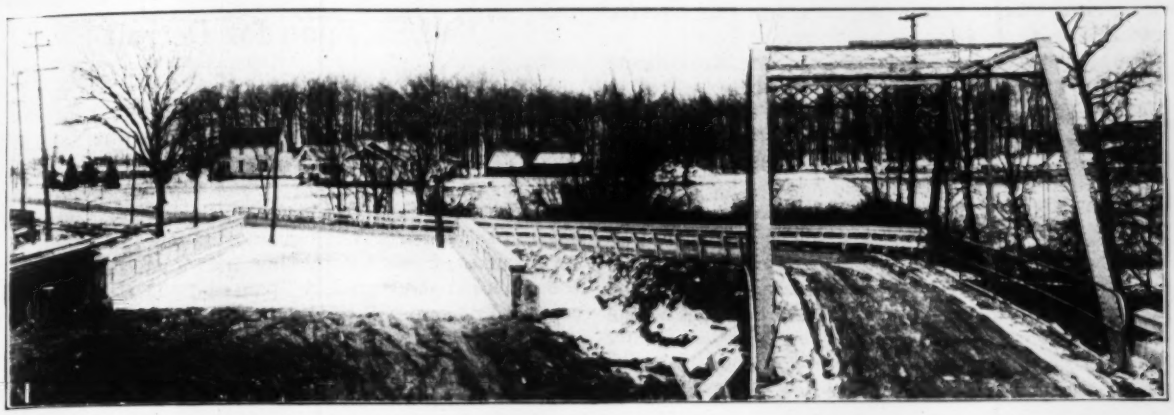
After a study of the situation it was decided to be unsafe to attempt to move the present bridge into this new location because of its poor condition and inadequate strength to carry present-day traffic. Fortunately the Michigan Central Railroad, in accordance with the orders of the War Department for improvement of the River Rouge, was building a new bascule bridge ½-mile upstream from the county's bridge site and was willing to sell its old drawspan.

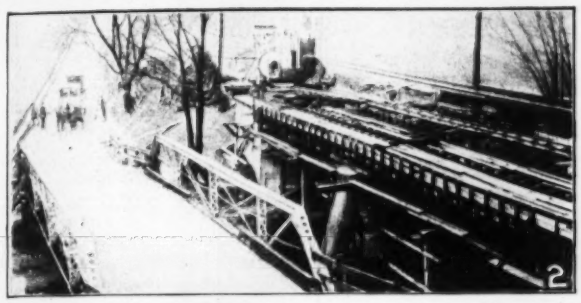
According to pre-arranged plans a flotilla of scows was on hand when the day arrived to take over our project. The scows were pumped nearly full of water and towed under the bridge at the Michigan Central Railroad crossing. By unwatering the scows the 600,000-lb. bridge was raised clear of its foundations and towed downstream (Fig. 6) to its new resting place as a detour for Jefferson Ave. traffic. By filling the scows with water again the bridge was successfully landed on its new foundations.

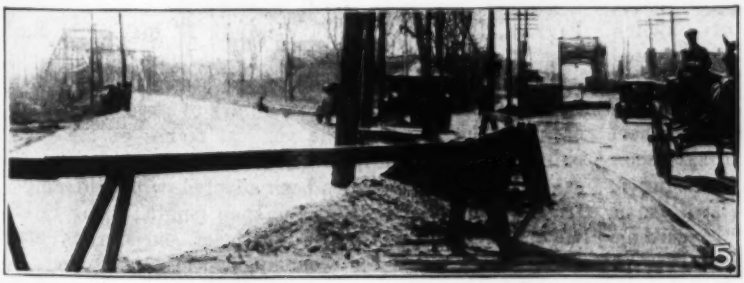
The floor of the bridge was then planked, a sidewalk was constructed and rails laid for the Detroit United Railway. The detour thus provided is now serving traffic in an effective manner.

On Plymouth road, halfway to Plymouth from Grand River, is another ingenious detour. The old span was a light and narrow, 16-ft. wide, clear through truss span, 100 ft. long, supported on flimsy foundations. The new span is a heavy pony truss span, 120 ft. long and having a clear width of roadway of 24 ft. It is supported on heavy and substantial concrete foundations. The old bridge is at one end of a very narrow roadway on a high fill which will be widened to give the equivalent of a 24-ft. gravel road, thus eliminating a serious obstacle to traffic.

The foundations for the new bridge which were built last winter were constructed without interruption to roadway traffic. The excavation for the new foundation was spanned by temporary bridging. The new steel structure was erected with only one or two half-hour interruptions to traffic and one interruption of half a







How Wayne County Provides Detours for Vehicular Traffic

Fig. 1. Plymouth-Northville Road Detour at New Bridge. Fig. 2. How Traffic Was Routed Around a Second Bridge, Plymouth-Northville Road. Fig. 3. Plank Road Detour at Gratiot Road Where Sewer is Under Construction. Fig. 4. Macadam Road Built to By-Pass Vehicles on Seven-Mile Road. Fig. 5. Concrete Road Detour at River Rouge Bridge Crossing. Fig. 6. Floating Temporary Detour Bridge to Place at Jefferson Ave.

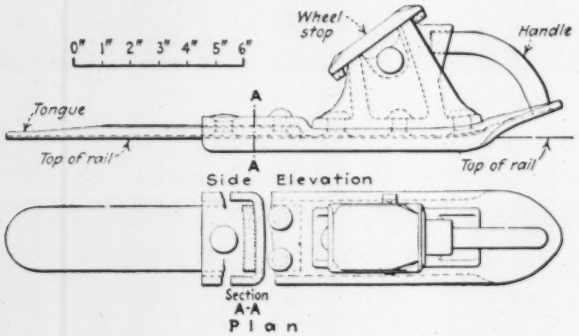
day. The latter was so timed as to occur when traffic was a minimum and when dry weather had left the detours in good shape.

The new steel trusses were erected on falsework on either side of the old bridge. The old bridge was then jacked up about 3 ft. to allow the floor of the new bridge to be built underneath the old bridge. It was during this jacking that the half day tie-up occurred. A plank roadway was built on half of the new bridge floor and the old bridge was then removed. Traffic used this plank roadway while a concrete roadway was poured on the other half of the new bridge. After the concrete had set sufficiently traffic was turned on to it and the plank roadway torn out to allow the other half of the roadway to be concreted.

These various detour expedients are much appreciated by the travelling public, and are great savers in time, tires, and gasoline consumption. In many instances traffic would be taken out of its normal channels from 3 to 5 miles.

Skid Brake for Gravity Switching

A SLIDING SHOE or skid to check cars in gravity yards has been introduced on the Northeastern Ry., England, and is shown in the accompanying drawing. Since an English freight car has its brakes operated by a lever at the side, with the operator standing on the ground, it is necessary in gravity switching to let the car travel unchecked on the classification track or to have a man run beside it from the foot of the hump grade. The former practice results in more or less



ENGLISH SKID TO STOP CARS IN YARDS

damage to cars and freight, but the latter is dangerous on account of the number of rails and switches to be crossed. The skid is a flat plate, held on the rail by flanges and having one end beveled to receive the car wheel. The other end is bent up to ride over switch points and irregular rail joints and has a stop riveted to it.

When the wheel engages the tongue of the skid the movement of the car is checked, and when the wheel strikes the stop the friction between rail and skid soon brings the car to rest, with a slight recoil causing it to back off the inclined tongue so that the switchman can remove the skid with a hooked stick. According to the *Railway Gazette*, London, a car or cut of cars moving at 15 m.p.h. can be stopped in twice its length by the skid. It is stated that, since the switchman remains at the yard tracks and the car moves freely until it approaches its destination, greater speed can be made in putting cars over the hump. This skid brake is the invention of O. H. Lindberg, assistant superintendent.

Eight-Cable Suspension Bridge of 1803 Ft. Span for Detroit

Double-Deck Construction to Accommodate Railway and Highway Traffic— Four-Cable Bridge at First

DEVELOPMENT of the plans for the Detroit River bridge to connect Detroit and Windsor, a project that has been under consideration during the past two years, has progressed far enough to put into concrete form some of the outstanding individual features of the proposed structure. A span of 1,803 ft. center to center of towers will be required, and for this purpose

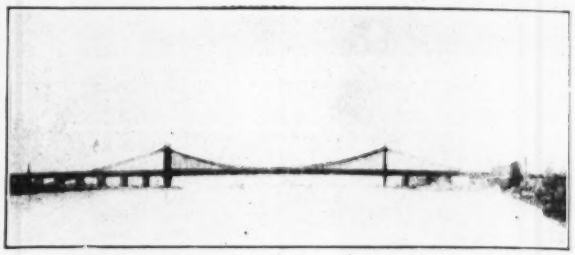


FIG. 1. HOW THE DETROIT RIVER CROSSING WILL APPEAR

a suspension bridge with unloaded backstays, carrying two decks for separate accommodation of railway and highway traffic, has been designed. The plan has been adapted to the requirement of construction in two stages, the highway deck to be constructed first and the railway deck to be added later together with the cables and extra stiffening-truss capacity required to take care of it. The unprecedented span length and the high load capacity necessary for the service to be carried made the design a difficult problem. Some drawings of the design prepared by Charles E. Fowler, chief engineer, and D. B. Steinman, assistant to the chief engineer, are reproduced herewith.

During the past few months the interests back of the bridge have obtained the necessary authority from Congress and from the Dominion Parliament through the granting of charters to an American and a Canadian company for the construction of the bridge. These companies have since been organized for joint action. Arrangements have also been concluded with a security brokerage house to sell the bonds and stock of the enterprise. In the meantime an advisory board of engineers has been formed, comprising George H. Pegram, Prof. William H. Burr, C. N. Monsarrat and Prof. C. R. Young.

The principal dimensions of the structure are given in Fig. 2 herewith. The towers are of steel, consisting each of four posts in the vertical planes of the four pairs of cables (one pair to each stiffening-truss). A sag ratio of one-tenth has been adopted, with stiffening-truss depth one-fiftieth of the span length; a sag ratio of one-ninth and a truss depth of one-sixtieth are being investigated for economy, deflection and general appearance of the structure. The sag in question is the mean of that of upper and lower cables. The two decks are spaced the full depth of the trusses. The lateral system has a paneling of four times the length of the stiffening-truss panel.

On account of the heavy loading, special effort has been made to utilize the material to fullest efficiency by

careful adaptation of the unit stresses to the available strength. For the floor, normal concentrations have been taken into account, including E60 loading on the railway deck, with impact 50 per cent of that specified by the Pencoyd formula, for railway speed of 20 m.p.h.; for the major elements of the structure, a total live load of 36,000 lb. per lineal foot of bridge (24,000 lb. for four railway tracks, 5,000 lb. for two trolley tracks, and 7,000 lb. roadway and sidewalk load). This is regarded as full or "congested" loading, a condition that would probably never be possible of realization as a test load, and to which extreme unit stresses might be applied. The normal live load, for the application of normal unit stresses, is made up of three-quarters of the congested railway load (four tracks at 4,500 lb.), 40 per cent of the trolley load (two tracks at 1,000 lb.), and

Eight cables proved necessary primarily because of the long span and great load. Cables of 21 in. diameter were considered the largest practicable for construction and efficiency. However, this arrangement also afforded a ready solution of the problem of two-stage construction. Six of the eight will be 21 in. in diameter, containing 7,980 parallel wires each, of 0.192 in. diameter, galvanized. Two of them will be 18 in., with 6,700 wires of the same size. Wire of 215,000 lb. ultimate and 70% elastic limit was counted on, though material of about 10% higher elastic value may be obtained. The cables are to be continuous from anchorage to anchorage, and to be wrapped with No. 9 soft annealed galvanized steel wire; the suspenders will be pairs of galvanized-wire ropes 1¾- and 1¼-in. diameter. Maximum cable stress amounts to 19,700,000

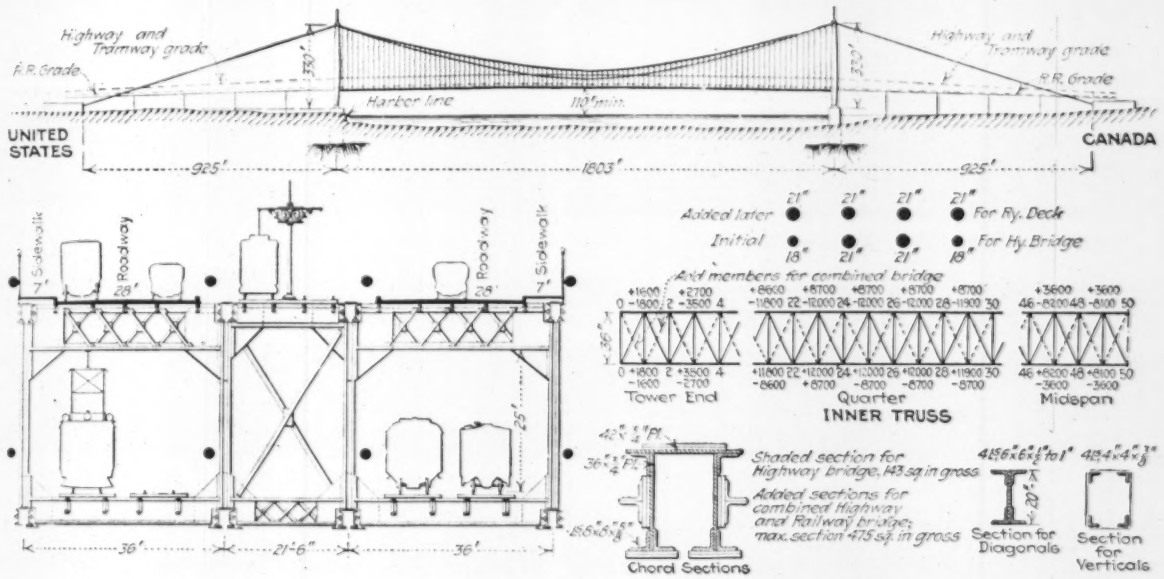


FIG. 2. DIMENSIONS AND STRUCTURAL ARRANGEMENT OF PROPOSED DETROIT-WINDSOR BRIDGE—TRUSS REINFORCEMENT WHEN SECOND DECK IS ADDED

half the roadway and sidewalk loading (50 lb. per sq.ft.), making a total of 23,500 lb. per lineal foot of bridge, or 65 per cent of the congested loading. Wind was computed at 30 lb. per square foot of exposed surface, including the projected surface of two trusses and train and traffic loading, a total of 1,850 lb. per lineal foot of bridge, considered as a moving load. The railway and highway floors will however absorb nearly half the lateral force. A temperature variation of 60 deg. F. above and below mean was allowed for. The suspended dead load for the design as worked out amounts to 37,700 lb. per lineal foot, of which the cables and suspenders make up 6,700 lb. and the four trusses 16,500 lb.

Unit stresses have been applied as follows, the two stresses given being in each case extreme and working, respectively: Cables, 100,000 and 85,000; suspenders, 50,000 and 40,000; alloy steel for towers and trusses, 45,000-150 l/r and 30,000-120 l/r; structural steel, 20,000-80 l/r. The extreme stresses are to be applied to congested loading and temperature, or to normal loading with temperature and wind. The working stresses are to be applied to normal load and temperature, or to empty bridge with temperature and wind.

lb. for a 21-in. cable, under normal load with temperature.

As the development of railroad traffic arrangements and connections is believed likely to delay the realization of the project if construction to full capacity at the start is contemplated, the present intention is to build a highway bridge first, under such method of construction that only so much is built as is necessary to support the highway deck, while at the same time the additional supporting and carrying structure for the railway deck can be provided by direct attachment to the original bridge. Accordingly the design is such that the four lower cables (inner 21 in., outer 18 in.), the four stiffening-trusses, and the entire upper deck structure could be built first, but with the omission of one (of two separate) web systems and of reinforcing plates of the chords of the stiffening-trusses. The second or upper set of cables would be reeved and assembled only when the railway or lower deck is required. These cables, separated near midspan from the lower ones by a height of some 20 ft., are to pass over saddles directly above the saddles of the lower cables and then run closely parallel to them along the backstay length to separate anchor chains. Anchorages, tower piers

and towers are to be built of full capacity in the beginning, on account of the difficulty or impracticability of two-stage construction.

Two special elements of the structure are sketched in Fig. 3, showing one of the towers and one of the anchorages. The four posts of each tower are portal-braced instead of being connected by full diagonal bracing. Below roadway level they are braced by transverse diaphragms. While these towers are to be built of alloy steel, the working stresses in compression will not exceed 35,000-140 l/r even under congested loading. The maximum compression in an inner tower post is 30,500,000 lb., for working live-load conditions, with extreme temperature and wind action. The towers are hinged at the base to allow for movement of the saddles due to temperature change of the cables. Their weight is about 20,000,000 lb., while towers fixed at the base would be more than twice as heavy.

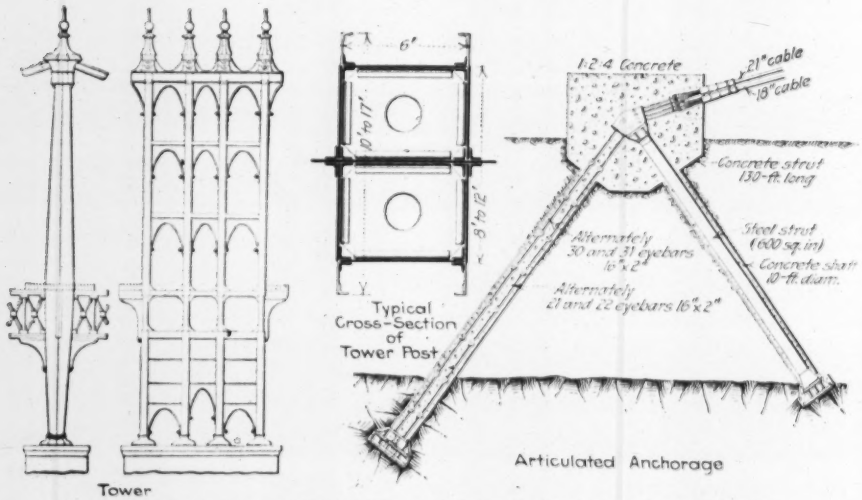


FIG. 3. PORTAL-BRACED TOWER AND STRUT-AND-TIE ANCHORAGE, DETROIT BRIDGE

The stiffening trusses were designed two-hinged for reduction of deflections and to avoid high suspender loads near midspan such as may occur with a center hinge; the weights of two-hinged and three-hinged truss were found to be about equal for the conditions of the Detroit bridge.

Unloaded backstays were used primarily on account of a curve in the railway approach, but the avoidance of large deflections in the side spans and decrease of main-span deflection were considered weighty additional reasons for this type as against loaded backstays, although there was little difference in economy between the two arrangements.

For the anchorages the novel construction sketched has been devised to provide for direct transfer of the cable pull to the underlying rock with a concrete anchorage block only heavy enough for the desired solidity of construction and for the purposes of bracing the four strut frames. This is attained by providing an inclined strut from rock up to the anchorage saddle, from which saddle (taking the pull of one upper and one lower cable) two eyebar chains pass backward and downward into a pit in the rock containing anchorage girders. Both strut and anchor chains are incased in shafts of concrete as protection from corrosion and indirectly a reinforcement of the anchorage.

Progress in City Planning in the United States

BY JACOB L. CRANE, JR.
Cambridge, Mass.

IS THIS significant new movement, the re-planning of our towns and cities, really taking hold in America? Then where, when, and by whom has it been seriously undertaken? To answer these questions by a summary of the data now available, the writer has used principally a recent bulletin, "Municipal Accomplishment in City Planning," edited by Miss Theodora Kimball, Librarian of the Harvard School of Landscape Architecture. The study has been confined to the replanning of existing cities and their environs, and does not include the laying out of new villages. Only those cities have been included where comprehensive replanning has been done for the entire community. Full data are not yet available from several cities where re-planning has been done, but on each question proposed sufficient information was tabulated to indicate the trend in the movement.

The work undertaken so far has been confined mostly to the larger towns. All of the first sixteen cities in the United States are in this list; and 57 of the first 100 are here. There are at least 1,700 towns of over 5,000 population and virtually all of the villages and rural communities where this fundamental civic enterprise has still to be taken up.

WHO STARTED CITY PLANNING PROJECTS?

The city planning work in these communities was initiated directly by and the work done for the municipal governments, one department or another, in 65 cases; by citizens' committees, women's clubs, and special civic organizations in 25 cities; by chambers of commerce, boards of trade, and similar organizations in 8 cases; by city and chamber of commerce combined in 4 cities; by an organization outside the city altogether in 2 cases; by municipal art commissions in 2 cases; and by the federal government in 2 cases. Features of these data are the large proportion of work started by the municipalities and that started by citizens' committees.

City planning, arising as a new profession, has drawn men from various older professions. Table II shows the number of cities which employed experts from the several professions indicated. While many of the experts are now classed as City Planners, they are here included in the group of the older profession to which they also belong. In some cases, where several men were engaged, it has been necessary to class a city in the group of the expert who headed or directed the work. The technical work done by city forces is usually directed by the city engineer, often with the co-operation of the park board and the other departments.

TABLE I. GEOGRAPHICAL DISTRIBUTION OF CITY PLANNING

	Undertaken Planning*	City Planning Coms.†		Undertaken Planning*	City Planning Coms.†
Massachusetts	15	41	Maine	2	1
Pennsylvania	13	28	Maryland	1	1
California	10	19	New Mexico	1	1
Ohio	6	9	North Carolina	1	0
New York	10	6	Oklahoma	1	1
Michigan	7	5	Oregon	1	1
Connecticut	4	4	Rhode Island	2	1
Indiana	1	3	Tennessee	0	1
New Jersey	8	3	Texas	3	1
Washington	2	3	Utah	0	1
Wisconsin	3	3	Virginia	2	1
Illinois	7	2	West Virginia	0	1
Iowa	4	2	Dist. of Columbia	1	0
Kansas	0	2			
Minnesota	3	2	Total	120	148
Missouri	2	2			
Nebraska	1	2			
South Carolina	2	0			
Alabama	1	0			
Arizona	1	1			
Colorado	4	0			
Georgia	0	1			

* Comprehensive city planning done and data available, with or without commissions.

† As of Nov. 1, 1920. Some have not yet produced evidence that work has been started.

PER CENT DISTRIBUTION

New England	20	32
Total East of Mississippi	73	76
Total in Northern States	80	80

Group	Number of Cities
Previous to 1900	2
1900–1905	3
1905–1910	26
1910–1915	38
1915–1920	51

CLASSIFICATION BY SIZE OF CITIES, 1920 CENSUS

Population Group	Number of Cities	Population Group	Number of Cities
Less than 5,000	6	Total 25,000–100,000	48
5,000–10,000	9	100,000–250,000	25
10,000–25,000	9	250,000–500,000	11
Total up to 25,000	24	500,000–1,000,000	9
25,000–50,000	29	Over 1,000,000	3
50,000–100,000	19	Total over 100,000	48

Most of the work grouped under civic expert was done by the late Charles Mulford Robinson. The landscape architect has directed more work than have members of any other profession. He has been the moving spirit behind the idea and the project in many cities. The engineer however has done more comprehensive city planning than may be commonly supposed, most of his work being as a member of the permanent city forces.

TABLE II. KIND OF PROFESSIONAL SERVICE EMPLOYED

Profession of Expert	Number of Cities
Landscape architect	36
City forces (engineering and other departments)	20
Civic expert	18
Architect	13
Engineer (outside of city forces)	4
Architect and landscape architect	3
Engineer and landscape architect	3
Engineer and civic expert	3
Landscape architect and civic expert	1
Associated landscape architect, engineer, and architect	2
Total in which landscape architect appears	45
Total in which engineer appears (including city forces)	32
Total in which civic expert appears	22
Total in which architect appears	18

It may well be considered that the soundest method of undertaking city planning work is by the forces of the city departments (preferably under a separate commission or board with a technical staff), since they are most responsive to the traditions and needs of the community. Outside consultant engineers, architects, landscape architects, and sociologists may be called in for advice on particular phases of the work. The tri-partite board—landscape architect, architect, and engineer—has proved most effective in certain instances, notably in the work of the U. S. Housing Corporation, which, however, has not been included in this study for obvious reasons. The individual who may combine the qualifications of these three in his own training, and add to them the insight of the sociologist, is perhaps best qualified to direct work as an individual. Always, however, numerous sources of local advice must be consulted, since city planning purposes to be the art of interpreting, formulating and making effective the best traditions and aspirations of the community, not of the expert.

Comprehensiveness of Planning Projects

It was possible to get only a most general idea of how detailed the planning work has been. Only 20 cities were found where the planning could be called "complete," while in 80 cities it could be termed "general," although not complete. While planning cannot be most effective unless it is complete in all details, the "general" planning on a comprehensive scale is invaluable because it forms the framework within which the complete details can be developed.

Out of 113 cities there were 62 with a plan commission or some comparable body, with the function of carrying on the planning as a separate municipal enterprise, and of recommending (or, in one case, ordering) the work to be done by the other departments. Somewhat less than half, 51, still operate through the existing city departments. Genuine progress has averaged much greater in the cities with planning commissions.

In at least 31 cities, out of probably 50 where some time has elapsed since the planning was done, many of the improvements recommended in the planning reports have been carried out, and in 38 cities at least some improvements which would probably not have been undertaken if it were not for the re-planning, have been put under construction. No city has started execution of all the proposals of a complete plan. Many, however, have definite programs for carrying out the projects through a period of years. This seems to be a sensible scheme of procedure. Only three cities state that the proposals of the plan have been ignored in the subsequent improvements, but there are about a dozen other cities where the present officials seem to be ignorant of the planning that has been done in their cities. An important element of putting the city plans into effect, namely the control of platting of annexed lands to accord with the plan, has been definitely adopted by at least four cities and in greater or less degree by many more.

Chicago leads in the execution of projects of fundamental importance to the development of the city. Philadelphia has started work on several huge projects. The execution of work according to city plans is definitely under way in: Akron, Albany, Baltimore, Boston, Cleveland, Dallas, Detroit, Flint, Milwaukee, Minneapolis, Pittsburgh, Rochester, St. Louis, San Francisco, Springfield, Mass., and Syracuse.

The commonest causes for delay in converting plans into construction projects are the obvious ones of lack of public support and particularly lack of financial support. The latter has been an unusually severe drawback during the period of war activity and war prices.

Most popular interest is liable to center in individual projects, one or two at a time, and so long as these projects are a part of the plan, it is practical to carry out work in this way. Much recent interest has been in the housing deficiency and many planning reports include, as they properly should, sections on housing facilities.

At the present moment zoning is by all odds the most active phase of city planning work. Its popularity may

be attributed to the facts that its benefits are easily understood, immediately available, and easily and cheaply secured. The zoning work will be valuable, but its full effectiveness cannot of course be secured unless it goes hand in hand with comprehensive planning, in fact it has been shown that zoning without planning may be a dangerous expedient.

State Interest in City Planning

State interest in city planning projects has shown at least two important recent developments. In Massachusetts, following the compulsory Town Planning Commission law of 1913 and the enabling Survey act of 1916, the old Homestead Commission has lately been superseded by a Division of Housing and Town Planning in the State Department of Public Welfare. It is expected that this bureau will serve to stimulate the execution of plans in Massachusetts. In Pennsylvania the recently established Division of City Planning of the State Bureau of Municipalities has been carrying out a regional survey in the Wilkes-Barre region.

The data here submitted showing the progress and the tendencies in the art of city planning seem noteworthy and prophetic. The movement promises a complete rehabilitation of urban environment in the United States. The engineer's part in the work will become increasingly important as he interests himself in the broader functional planning of towns and cities.

20-In. Suction Dredge Operated Entirely by Electricity

THE 20-in. suction dredge, "Tacoma," which is operated by the Marsh Construction Co. on the Sumas River in Washington, was recently converted from steam to electric operation. As now arranged, it has a total connected load of 1,322.5 hp. and uses motors ranging in capacity up to 1,000 hp. Both 2,300- and 440-volt current is used, a cable and reel maintaining connection with the shore as the dredge moves forward in its work.

The source of the energy is a 34,000-volt transmission line which parallels the line of operation of the dredge. Leads tapped onto this high tension line run to a bank of three 500-kva. transformers mounted on a scow which is moored to the bank of the river. Scow and dredge are connected by a 1,000-ft. length of submarine cable carried by a reel mounted on a small scow lashed to the dredge; the cable being automatically paid out as the dredge moves ahead. When the cable is all reeled out, the transformer scow is cast adrift and moved ahead, the slack in the submarine cable is coiled up on the reel, and new connections with the transmission line are served to the transformer bank in its new location.

The two largest power units on the dredge are the 1,000-hp. motor which drives the main pump at the rate of 300 r.p.m and the 150-hp. motor which operates the cutter by means of reduction gears. Early in September, after a few weeks of operation, the dredge was reported to be moving material at the rate of about 600 cu.yd. per hour at a power cost of 1 to 1¼ cents per cubic yard. Under normal operation the dredge requires from 900 kw. to 1,000 kw. and has a power factor of about 85 per cent.

The electrical features of the dredge were designed and installed by Thompson & Castleton, Inc., of Seattle.

Pronounced Reinforcement Corrosion Due to Sea Water or Electrolysis

By Welton A. Snow

Sandquist & Snow, Engineers and Contractors, Miami, Fl.

ON JULY 18, 1921, we were called to investigate the deterioration of reinforced-concrete floorbeams in the first floor of a residence located on one of the many island keys along the east coast of Florida. The building is located on a fill at the water's edge, with the foundation walls resting on piling, the first floor about 7 ft. above mean low water. The floor construction is hollow tile combined with reinforced-concrete joist with 4 in. concrete top finish. The tile are 8 x 12 in. with 4 in. concrete joist 16 in. c. to c., the bottom of concrete joist and hollow tile being flush. The joist contains two ⅝-in. reinforcing bars in long spans, and one ¾-in. reinforcing bar in the short spans.

We found upon going into the basement, that a section of the underside of the first floor had been fractured as shown in the view. The reinforcing steel in the beams was exposed as shown and fragments of concrete and tile were lying on the basement floor. The reinforcing steel so exposed was severely corroded, large flakes of rust being attached to the fragments of concrete found on the floor. The steel bars were materially decreased in area in many places and upon further examination of the rest of the floor we found that similar conditions existed, although concrete and tile had not been displaced. Existing cracks and hollow sounds noted when tapping the beams indicated severe corrosion.

On checking back over the history of the house we found that sea water had been used in the original concrete mix. We also found that direct current is used in the building and that the lighting system had been continually giving trouble. After carefully studying these conditions and consulting all available literature at hand relative to the corrosion of reinforcing steel in concrete we arrived at the following conclusions.

(1) Undoubtedly the fact that salt water had been used in the concrete mix accounts for rusting of the steel to a certain extent.

(2) The fact that the basement ceiling and walls had been constantly exposed to warm salt water vapor and had not been damp-proof tended to increase the rate of corrosion.

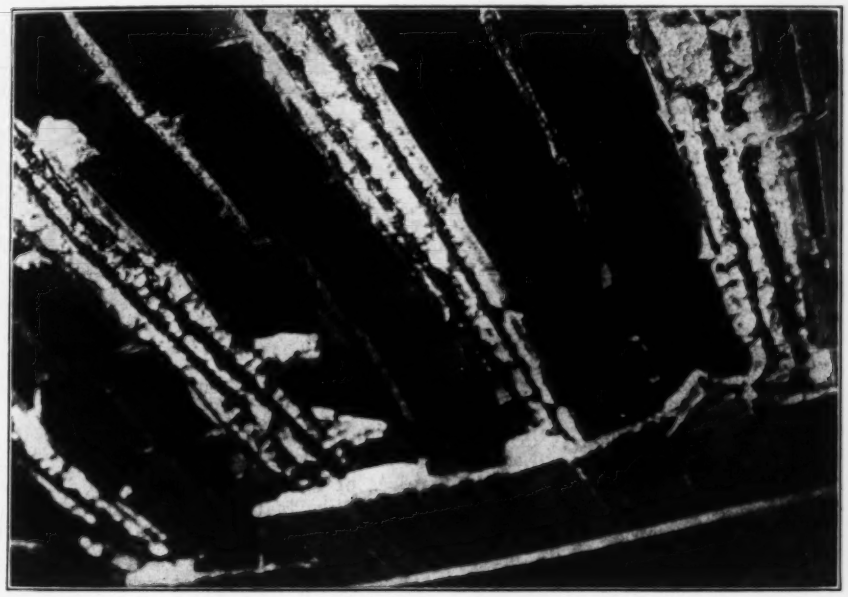
(3) All indications seem to point to severe ground electrical currents in the building, such currents very likely passing through the reinforcing steel in various sections.

Conclusion No. 3 we believed to be the most serious condition and consequently our first step was to take a thorough examination and test of the electrical system for ground circuits. As a result of this, we found two especially severe grounds in the lighting circuits. The worst one of the two circuits passed through the general area in the basement where the most serious corrosion of steel was taking place. At three points in this circuit the insulation had been penetrated and the copper was in touch with the conduit, which in turn was in direct contact with the concrete beams.

As a result of our findings we believe that the severe corrosion of the reinforcing steel in this instance was primarily caused by the constant exposure of the unprotected beams to warm salt water vapor which penetrated through the rather coarse concrete to the

steel; that the ground circuits in the building materially increased this corrosion causing excessive action and the concrete and tile to fracture; that the salt water used in the original mix tended also to help the corrosive action to a great extent.

The concrete is of average quality for this section of the country. The rock used almost entirely in the southern part of Florida is a rather soft rock, an oolitic limestone formation, in many instances of a coral formation. The sand used is for the most part that known as beach sand, containing a great many small particles of broken shells. With these aggregates, the resulting concrete is not as hard or as dense as the concrete obtained in the north where a harder rock is used and a much sharper sand. Therefore the concrete of average quality used in this section of the country with no waterproof coating is more easily penetrated by moisture than concrete in the north. It may be that a chemical reaction within the concrete itself has caused it to become porous and more easily penetrated by water vapor.



CORRODED STEEL CAUSES BREAKING UP OF PROTECTING CONCRETE

Rainstorm Totals at Providence, R. I.

The total precipitation for each period of rainfall at Providence, R. I., in the 43 years from 1877 to 1920 was 8, 7 and 6 in. once each; 5 and 4½ in. three times each; 4¼ in. once; 4 in. twice; 3¾ in. six times; 3½ and 3¼ in. 12 times each; 3 in. 15 times; and so on in increasing numbers of times until 174 storms each of 1¼ and 1 in. respectively are reached, according to the 1920 report of M. H. Brondson, city engineer of Providence. From that point on the figures are given for each tenth of an inch, reaching 630 rainfalls of 0.1 for the 43 years or an average of 14.3 such rainfalls per year. For the same period there were 306 rainfalls of 0.01, or an average of 7 such a year. Rainfalls between the depths reported are credited to whichever depth they are nearest. The 8 in. rainstorm was in 1886, the 7-in. in 1899 and the 6-in. in 1904.

Practical Economics of Dredge Pump Design

Smooth Flow Lines Require Less Power—Wear Reduced and Output Increased—Two Designs Compared on Actual Work

By E. J. Dent

Lieut.-Col. Corps of Engineers, U. S. A., U. S. Engineer Office, New Orleans, La.

DREDGING superintendents cannot be expected to qualify as expert designers of centrifugal pumps. There is, however, one item in the design of dredge pumps which the outdoor superintendent can readily appreciate and which he should insist upon having incorporated. This item is smooth flow lines. Without smooth flow lines, a dredge pump becomes a serious waster of power, a machine for churning water as well as for pumping it, and a machine for using the sand and gravel pumped as a sand blast for wearing out the machine itself.

Wear and tear on dredge pumps varies greatly with the material handled and the lift against which it is being pumped. The wear is always so great that the men in charge of dredging operations are quickly impressed with the cost of buying spare parts and with the cost of delays incident to the installation of these spare parts. With these expenses before them, they have insisted upon designs in which the spare parts cost a minimum for manufacture and upon an assembly which permits the installation of the new parts with a minimum loss of time. Generally the power consumed receives little attention for the reason that it cannot be readily measured. The cost of wasted power is, however, in many cases far greater than the cost of repairs. Moreover, a design calculated to economize in the expenditure of power may often show an economy in replacement expenses.

Two Designs Tested

These general statements are well illustrated by the installation made at the writer's suggestion, of an improved design of pump, Fig. 2, on the dredge "Raritan." This dredge is of the seagoing hopper type and is equipped identically except that one pump is a right and one a left. The pumps discharge into two bins, one located in the forward end and one in the after end of the vessel. The yardage excavated is measured accurately by the bins.

After the new pump had been installed, comparative tests were made. A number of loads were dredged, using one pump at a time. After a load had been obtained with one pump, a second load was dredged with the other pump under as nearly identical conditions as possible. Later the pumps were so connected up that

they could be operated simultaneously, one pump discharging into the forward bin and one pump into the after bin.

In the case of the "Raritan" the increased efficiency of the new pump was utilized to increase the output of the dredge without changing the expenditure of power. The installation of a more efficient unit had precisely the same effect upon the capacity as would have been obtained by the installation of a more powerful unit having the same efficiency as the one replaced. The results of actual dredging tests are summarized below and are expressed in terms of percentages, the output of the old pump being called 100 per cent:

	Old Pump	New Pump
Six loads, 3 classes of material	100	115
Six loads, 3 classes of material	100	96
Nine loads, 3 classes of material	100	164

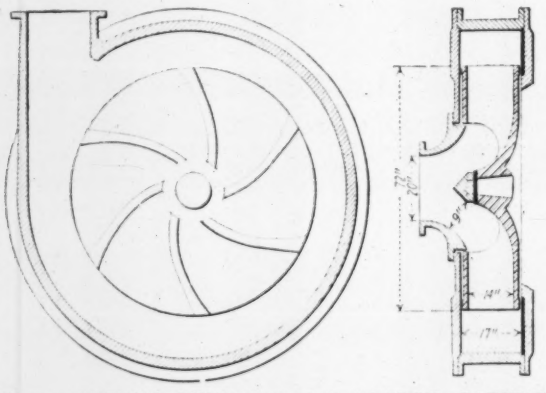


FIG. 1. ORIGINAL PUMP FOR U. S. DREDGE "RARITAN"

The moral of the above figures is obvious. The increased output of the plant was obtained without any additional expenditure for power. Operations since the new pump was installed have shown that the wear and tear on the new pump is less than on the old pump and that the cost of new parts, including their installation, has been reduced.

The acceptance trial of the new pump was made while pumping water only, under conditions as nearly identical with actual dredging conditions as could be obtained. If the old and new pumps had been operated by electric motors, with watt-meters attached for recording the power consumed, and if the two pumps had been adjusted to deliver identical quantities of water against identical heads, the results would have been about as follows:

Kilowatts used by the old pump	335
Kilowatts used by the new pump	260
Kilowatts saved	75

That in ordinary dredging operations the power consumed by the pump is not recorded does not alter the fact that with a pump of poor design a very expensive waste of power, such as shown above, is actually taking place. The pumps on the "Raritan" are operated over 3,000 hours each year. An annual wastage of 225,000 kw.-hr. is not to be despised.

The accompanying figures show the new pump for the dredge "Raritan" and the pump which it replaced. The new pump was designed by Henry R. Worthington in accordance with specifications prepared by the writer. In preparing the specifications, every effort was made to obtain a pump suited for dredging conditions and at the same time to incorporate in that pump every feature found in high efficiency waterworks pumps, so long as those features were not incompatible with dredging operations. The most important changes were the elimination of the angular form of hub shown in the old pump, the conversion of the runner into what may be called a long sweep elbow, the extension of the inner tips of the vanes to a point as near the axis as possible, the elimination of an excessive width of vane at the outer periphery, the elimination of the sudden enlargement of the water passages at the outer periphery of the old impeller, and the incorporation of small vanes on the outside of the impeller on the suction side with a view to the reduction of circulation losses. The new pump has openings that will pass solids slightly larger than solids that can pass the old pump. The new pump has worn better than the old pump. If conditions require a thicker volute, it can readily be provided without altering the essentials of the design.

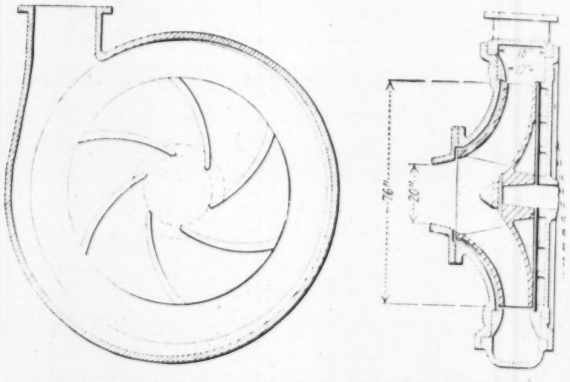


FIG. 2. NEW PUMP FOR U. S. DREDGE "RARITAN"

Certain features of a dredge pump are so different from the corresponding features of a high efficiency waterworks pump that many designers assume from the beginning that high efficiency is unattainable. The following figures, giving the actual results obtained with the new pump on the dredge "Raritan" show that in this instance suitability for dredging operations was not incompatible with high economy:

Revolutions per minute	150
Output, cubic feet per second	51 7
Total dynamic head	50 8
Combined efficiency of pump and engine	72 4

The writer believes that the results on the dredge "Raritan" should receive consideration by both dredge operators and pump manufacturers. It rarely happens that a dredge pump is found in which some fundamental error in hydraulic design has not been incorporated

Redwood Survey Stakes Stand 47 Years

Redwood stakes driven into the ground along the California coast by the United States Coast and Geodetic Survey in 1874 are reported to be still in a fair state of preservation. The stakes are 2 x 3 in. in section and were not painted. Old corners which were marked by these stakes are being located again in connection with the accurate determination of the position of the new radio compass stations along the California coast, which is now being done by the United States Coast and Geodetic Survey. One of the stakes taken from Point Arguello is being sent to Washington to bear out the report of long service.

Some Examples of Corrosion of Reinforcing Steel

Fourteen Structures in Which Chemical Action Had Caused Steel Rusting and Partial Failure of Concrete

By Frank P. McKibben
Civil Engineering Department, Union College, Schenectady, N. Y.

IN CONNECTION with articles in recent issues of *Engineering News-Record* describing the collapse of a reinforced-concrete roof slab in Atlantic City the following observations pertaining to corrosion of steel reinforcement in some structures which I examined in 1913 may be of interest.

In each of the fourteen structures hereinafter mentioned, corrosion of the reinforcement was very marked, in several cases so much so as to cause danger. Corrosion of the steel may be due to chemical action or to electrolysis. I am sure that in no structure examined was electrolytic action present. Chemical action, generally due to the presence of salt, caused the steel rods to rust, thereby increasing their diameters and resulting in a tension which caused, in the surrounding concrete, cracks parallel to the rods.

Meat Packing Plant in Buffalo.—This structure, used for curing and packing meat, was subjected to much moisture and salt. For the most part the floors consisted of concrete slabs 8 in. thick reinforced with steel mesh, the slabs being supported by I-beams or wooden beams. Some I-beams were entirely encased in concrete, and others only partially so. Because of corrosion of I-beams or reinforcing mesh the concrete was cracked, blistered or pushed off in many places. At one point the corrosion of the mesh pushed off the concrete protection on the bottom of slabs leaving the metal exposed over an area of 2 by 14 ft. In many places in this building the mesh was completely rusted away leaving only rust-stained marks on the concrete. The concrete covering the bottom flanges of many I-beams which supported floor slabs was cracked parallel with the steel. Alternating current which was used within the building for light and power does not cause electrolysis of steel in concrete.

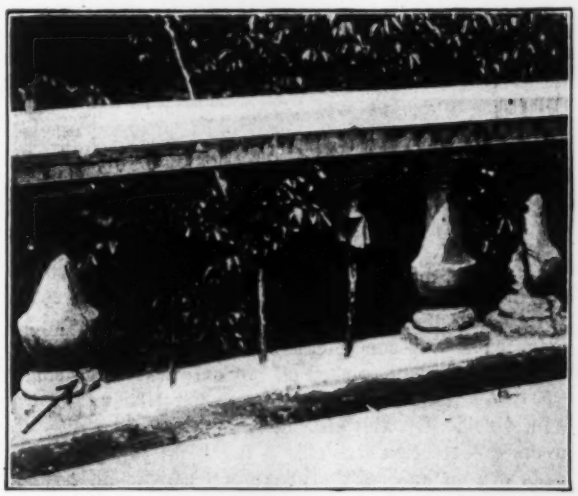
Residence in British West Indies.—This residence, a very elaborate reinforced-concrete structure of two stories, stood about 150 ft. from the sea shore and in many places the concrete was either cracked, blistered or pushed off from the steel. Exposed rods were in every case very rusty even in the ceiling of a bed room. Both in the interior and on the exterior of the building all cracks in concrete were parallel with reinforcing rods.

An adjoining pavilion, a reinforced-concrete structure consisting of a floor on which stood eight columns supporting a dome-shaped roof, was about 18 ft. high and 21 ft. in diameter. The columns and roof were reinforced and as a result of corrosion of imbedded steel the concrete was pushed off in many places leaving the badly corroded rods exposed, while in other places the concrete was cracked and blistered and stained by rust from within. A reinforced-concrete bridge was near the pavilion and in many places the concrete was pushed off by corrosion of imbedded rods.

There were no electric wires near the pavilion or the bridge, but the residence was lighted by alternating current. I was informed that salt water and unwashed sand from the sea were used in mixing the concrete.

Reinforced-Concrete Bridge Model.—This reinforced-concrete girder bridge was a model 28 ft. long built in 1903 and rested upon four masonry piers in the yard of a testing laboratory. The bridge after 10 years was very badly disintegrated, the concrete being cracked off or blistered in hundreds of places leaving the very rusty steel exposed to view. As the structure was many miles from the sea and as no electric current was within at least 100 feet, it seems quite evident that the concrete protection outside of the steel was so porous and thin as to allow the steel to corrode from atmospheric causes.

Railing Near Nice, France.—The view shows the form and disintegration of a concrete railing bordering a sidewalk on a hill approximately 270 ft. above the Mediterranean Sea and about one-quarter mile therefrom. Each concrete spindle of the railing had a minimum diameter of 4½ in. and was reinforced axially with one or two steel rods extending from the bottom of the spindle, upward through the spindle into the railing on top. As a result of corrosion of the central reinforcement, out of a total of 39 spindles in the central section of the railing every spindle was cracked or badly disintegrated, some having been completely destroyed.



DETERIORATION OF CONCRETE RAILING NEAR NICE, FRANCE

The thickness of the concrete around the steel was generally 1½ in. but the minimum thickness was 1 in. As the spindles rested on a concrete wall, water could easily penetrate the horizontal joints between the spindles and the wall thus initiating corrosion at the bottom of the reinforcing rods with consequent splitting of the spindles from the bottom upward as shown in the spindle at the left end of Fig. 2.

Structures at Atlantic City.—One of the best known amusement piers at Atlantic City was carried on reinforced-concrete beams which were so badly disintegrated that wooden piles were inserted to support the pier. The reinforced-concrete beams were practically useless because corrosion of the steel reinforcement split off the concrete below and around the rods in many cases throughout the entire length of the beams. For example, in one series of 13 beams, all were in bad condition, while in another series of 13 out of 14 beams were also disintegrated and of no value in carrying load.

A small pavilion, also in Atlantic City, was about 20 ft. square and was carried upon nine reinforced col-

umns resting on the beach, the reinforced-concrete floor being about 10 ft. above the beach. Here again the concrete was badly cracked, blistered or pushed off exposing rusty steel in many places. The cracks and blisters had characteristic rust stains from the rusting steel within. The extent to which the structure was damaged in 1913 was indicated by the presence of 75 places on the hand railing alone where steel was exposed.

Another pavilion at Atlantic City was a reinforced structure about 45 ft. long by 30 ft. wide, and was badly disintegrated by rusting steel reinforcement. In several hundred places rust stained blisters occurred in the concrete, which upon being broken open invariably revealed corroded steel. In the main reinforced-concrete beams supporting the floor slab cracks from 2 to 6 ft. long existed parallel with the rods within.

The disintegration similar to that just described in the pavilion was also taking place at the following structures at Atlantic City: Reinforced-concrete beams supporting floors of two well known amusement piers along the Boardwalk, reinforced girders supporting the Boardwalk near Victoria St., pavilion on Boardwalk at foot of Atlantic Ave., a new apartment house on the Boardwalk. This apartment house case is interesting because the building was fairly new when examined, and because the concrete veneer under the reinforcing rods of beams had cracked off not only where the veneer was thin but in at least one place where the veneer was 3 in. thick. On the side of this beam, however, the concrete protection was only 1 in. thick.

More than half of the above structures had no electric wiring and in those which carried wires the current was alternating. Moreover, electrical readings showed no evidence whatever that electrolysis was in any way connected with the corrosion of the steel, and, furthermore, the character of the corrosion indicated clearly the usual chemical corrosive action. It will be observed that of the above noted fourteen structures showing evidence of steel corrosion all but two were near the sea coast; and of these two, one was a meat packing plant subjected internally to much moisture and salt.

By calling attention to these structures it is not my purpose to indict reinforced concrete, for the above are only fourteen structures contrasted with many thousands of others which are rendering good service. My purpose is to call attention to the importance of careful designing, careful building, and careful inspection, both during and after construction, of reinforced-concrete structures located in exposed positions on the sea coast. Moreover, the owner should be given the facts. He should not be led to believe he has something as enduring as Verdi's "Il Trovatore" or Dante's "Divine Commedia."

Street Car Tracks Paved with Grouted Concrete

Large Mileage of Modified Hassam Pavement Being Laid in Detroit—Force Account Construction Adopted

CONCRETE pavement constructed by grouting coarse broken stone after the manner of constructing Hassam pavement, is being placed in the track zone of a large mileage of streets occupied by the new municipal street railway system of Detroit, Mich. The equivalent of about 40 miles of 16-ft. pavement is represented by the construction planned for 1921. A mile of completed track each working day, equivalent to half a mile of 16-ft. pavement, is the schedule contemplated and being rapidly approached. An immense construction outfit, to carry on work in several places at once, is securing the high speed. To assure the high quality of workmanship required for the success of grouted concrete, all work is being performed by force account under rigid engineering supervision.

Structure and Plant.—About 100 miles of new track construction is planned. Of this trackage 18 miles were completed in 1920 using a wood tie construction embedded in mixed 1:3:5 concrete. The remaining 82 miles, scheduled for 1921, is of different construction as indicated for double track by the drawings of Fig. 1. In a trench 17½ in. deep and 16½ ft. wide is a center drain. Over this and the whole bottom of the trench, is a 2-in. layer of slag. Then comes a layer of 1:2:4 mixed concrete embedding the steel track structure to just above the base of the rails. Over all is grouted concrete, called "compressed concrete" by the street railway department engineers.

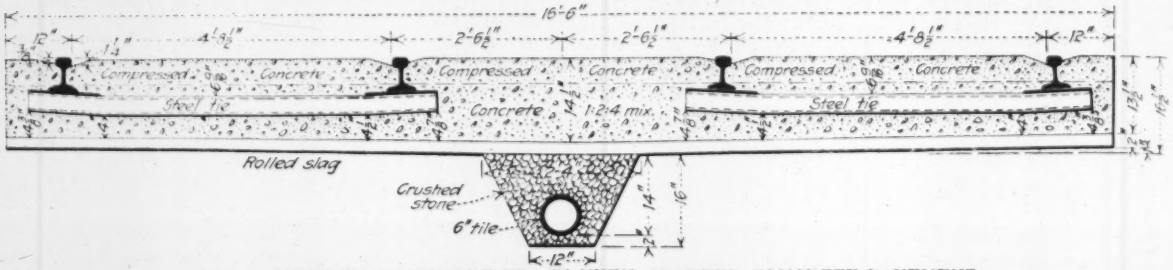


FIG. 1. SECTION OF DOUBLE TRACK WITH GROUTED CONCRETE PAVEMENT

Advantages of Design

As a design of street railway track, the construction illustrated is not so expensive as the wood tie construction because it requires 4½ in. less depth of trench. It provides particularly good drainage. The structure is a monolith of exceptional rigidity. Chiefly, however, it provides, it is considered, a pavement surface of much better quality, by using imported granite for the top course, than could be secured with mixed concrete, using local aggregates. It is the pavement construction which is chiefly of technical interest to the engineer concerned with highway design and construction.

An excellent plant is provided for the force account operations. The larger items of equipment are twelve steam shovels, six locomotive cranes, six concrete mixers, four locomotives and ninety industrial cars and four miles of industrial track besides special machines, such as rail welders and pole-hole diggers. About 200 motor trucks are being rented for hauling, and 1,800 men are employed in the construction force.

FIG. 2. CENTRAL MIXING PLANT AT STREET INTERSECTION

Preparing Track Foundation.—Construction is begun by opening a trench about 18 in. deep and 16½ ft. wide. In paved streets, generally asphalt on concrete, the trench sides are cut by chisels and the pavement between is broken up by the improvised breaker described in *Engineering News-Record*, July 28, 1921, p. 163.

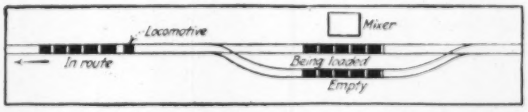


FIG. 3. DIAGRAM OF TRAIN MOVEMENTS AT THE MIXER

Steam shovels tear up the broken pavement and excavate the trench. The ditch for the tile drain is dug, the tile laid and the backfilling performed by hand.

Slag hauled in by motor trucks is spread over the trench bottom and rolled into the clay to a depth of 2 in. The purpose of this careful foundation preparation is to secure a dry track bed in an impervious clay. An 8-ton roller drives the slag into the clay and makes a very solid foundation bed and also one that keeps dry by drainage to the tile drain. The slag bed also makes an unyielding support for the precast concrete blocks on which the track is erected, leveled and welded by methods usual in electric railway construction.

FIG. 4. CONCRETE CARS DISCHARGE ONTO SHOVELING PLATE

Placing Mixed Concrete.—Mixed concrete for the main body of the track slab is hauled 1,000 ft. each way by industrial railway from central mixing plants. After a 2,000-ft. length is concreted the mixing plant is moved and re-erected at the middle point of another 2,000-ft. length. These mixing plants, as indicated by Fig. 2, are usually placed at street intersections. Here the concrete material is brought in motor trucks, unloaded onto the street and rehandled from the street piles to elevated bins by locomotive cranes operating clamshells. The bins are of knock-down construction, so as to be easily shifted. Regulation portable mixers with elevating charging skips are employed. They are moved from station to station by rollers or tractors and when set up stand in front of the bins so that the bin chutes feed directly into the charging skip. The cement is charged by hand. The mixers discharge directly into industrial cars holding 14-cu.ft. batches.

One locomotive and three five-car trains serve each

FIG. 5. SPREADING GRANITE FOR GROUTED CONCRETE

FIG. 6. ROLLING GRANITE BEFORE GROUTING

mixer. With a double-end switch at the mixer, the schedule of operation is as shown by the sketch plan, Fig. 3. Normally one train is in route, one is being loaded and one is empty on the siding. The train in route is pushed to the work, and, coming back, is pulled. The returning train pulls onto the siding where the empty cars are left while the locomotive couples onto the train previously on the siding, runs it out onto the main track and back to the mixer. There it lets the empty train stand while it couples to the train just loaded at the mixer and pushes it to the work. The empty cars at the mixer are spotted by hand, a car at a time, loaded and coupled up ready for the returning locomotive.

Where the concrete is being placed, the cars are

FIG. 7. GROUT DISCHARGE HEAD FILLING ROLLED STONE

dumped into a steel pan, Fig. 4, from which the batch is shoveled into the track. The surface is leveled up to templet and when stiff, is roughened to make closer bond with the paving course which is placed only when the base concrete is thoroughly set.

Placing Grouted Concrete.—Crushed granite from Wisconsin is used for the grouted concrete pavement course. It is required that the stones shall pass a 3-in. screen and be retained on a 2-in. screen and that the granite shall have a crushing strength of 12,000 lb. per square inch. This stone, piled along the street by motor trucks, is spread with forks, Fig. 5, to a level slightly above the rail tops and is then rolled with an 8-ton tandem roller until it is thoroughly compressed and keyed. The rolling requires care and skill but by starting easily and riding one side of the roller on the rail, Fig. 6, until initial compression is secured the operation is not difficult.

FIG. 8. SKETCH SHOWING FLANGEWAY FORMS

Grouting is the third operation. The mixer is a double tank paddle-mixer with an elevating skip on one side for charging. Each tank discharges through a spout with a strainer head. Grouting is done, toward the mixer, by swinging the head, Fig. 7, transversely across the zone being grouted and gradually backing up as the stone fills with grout. A 1:2 grout is used and pouring continues until it flushes to the top and covers the stone.

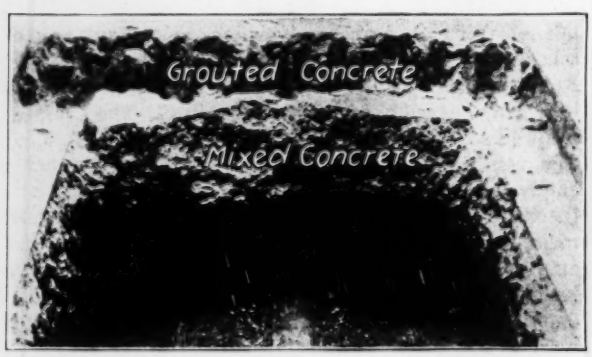


FIG. 9. SECTION THROUGH TRACK SLAB SHOWING QUALITY OF CONCRETE

When grouted the concrete is rolled, again using an 8-ton tandem roller, until no bubbles come to the surface and there is no wave ahead of the roller. Just before rolling the flangeway forms shown by Fig. 8 are placed. They are triangular timbers sheeted with steel. Following the rolling, men with tampers correct irregularities and rough spots. Men with brooms finally cross-brush the grout top.

Advantages of Grouted Concrete.—Grouted concrete was selected for paving the track zone because it was considered that a better pavement would be secured, and, because of its compression by rolling, a better bond with the steel track structure would be obtained. Its advantages are considered to be greater density, a more homogeneous composition, freedom from sand pockets and, by the use of large stone, greater endurance against wear. This perfection depends upon very careful construction and in particular upon perfect grouting. In grouting the greatest care is taken in respect to consistency and in the application, to secure penetration and complete filling of the voids from the bottom up. Where the completed pavement has been cut through in several places for inspection the penetration and bond has, it is stated, been found excellent. Fig. 9 is a view of one of these test pits made between tracks and excavated to expose the tile drain.

Resemblance of this pavement to Hassam pavement is noted. The construction is the same except that one size of stone is employed while in regulation Hassam construction a layer of coarse stone is first grouted and then a layer of finer stone and finally a surfacing of grout and pea stone is spread.

Construction is by force account with H. P. Hevenor, as construction engineer, and W. R. Dunham, assistant in direct charge.

Six Years' Experience with Convicts on California Road Work

In the six years since the first convict road camp was established in California, 1,235 men have been sent from San Quentin prison to road construction camps located in remote districts in the northern part of the state. Out of this total 55 men escaped or attempted to escape and of these 35 have been returned to the prison, and 20 are still at large. That is, 4.45 per cent of the convicts sent out on road work attempted to escape and 1.62 per cent were successful. At present 2,185 men are under committment to the San Quentin prison and 252 of these, or 11.53 per cent are assigned to one of the three road construction camps now operating in the northern part of the state.

In supplying the foregoing figures, J. A. Johnston, warden of the San Quentin prison, states; "I have considered the matter from the standpoint of its effect upon the individual—inculcating the habit of industry and developing the desire to render useful service—as well as the value of getting roads built in remote regions where otherwise construction might be long delayed and I am heartily in favor of the employment of prisoners on road work.

"We have a number of long term men assigned to road work. One man has been in camp since 1916; another since 1917; two since 1918 and eleven since 1919. Long term men are frequently selected and are just as good risks as men with short terms. A number of life term prisoners are working on the roads at the present time."

Curious Structural Layout in New British Reservoir

Combines Precast Concrete, Structural Steel, Brick and Reinforced Concrete With Groined Roof Panels

NATIONAL peculiarities of engineering design cannot be better illustrated than in a brief description of the new Cross Hill Reservoir of the Birkenhead water supply recently noted in the English technical papers. The views herewith are reproduced from "The Engineer" and "Engineering" and the following description is taken from the latter journal:

The Cross Hill reservoir has an area of 3.6 acres, the total available depth being 28 ft. The reservoir is covered and is of composite brick, concrete and earth construction. It is designed so that the thrust when full is taken by a surrounding earth embankment, but when empty the pressure of the latter is taken by a series of horizontal brick arches.

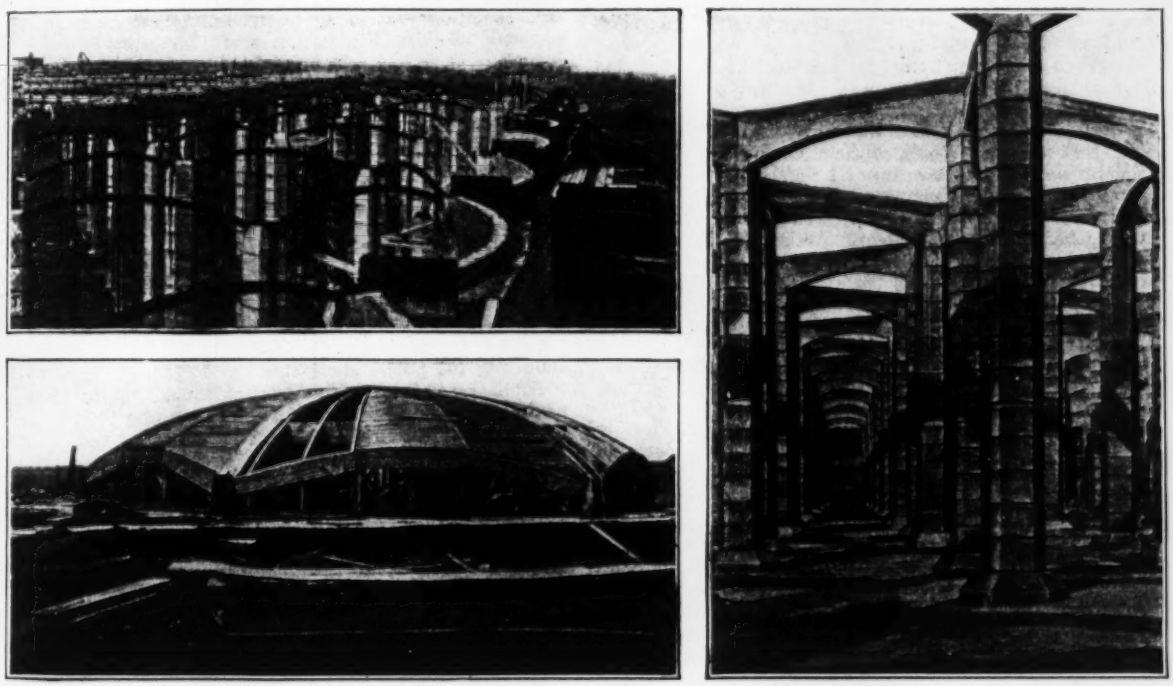
In plan the reservoir is hexagonal, each side being made up of eight horizontal arches of 30 ft. span and a radius of 27 ft. 6¼ in., with smaller spans at the angle points where two sides meet. At the springing of these horizontal arches there is in each case a vertical steel plate girder, 4 ft. over flanges by over 30 ft. in height. The bases of these vertical girders are embedded in concrete. The upper ends are tied to the interior structure of the tank as will be presently described. The girders are cased in concrete and special molded blocks which form the springers for the horizontal arches built of brindle brick. The latter work is 14 in. thick to 11 ft. 3 in. above the floor, and 9 in. thick above. It is backed by concrete, 12 in. to 18 in. thick, at the arch center and 5 ft. thick at the haunches, where it enclosed the plate girders. A layer of asphalt, ¾ in. thick, is laid between the concrete and brickwork. The earth bank outside is trimmed to a 2½ to 1 slope, the walls being 21 ft. thick at the top.

The reservoir is roofed in by 217 domes, supported by the side walls and 432 concrete island pillars. The majority of the domes are thus carried on groins connecting six pillars, the plan of each unit being a regular hexagon. The pillars are of molded hexagonal concrete blocks, 18 in. deep, chamfered top and bottom. A 6-in. hole is cored in the center, and this was filled with cement mortar. At the top a steel gusset plate is fixed, and to this gusset are attached the ends of the joists forming the reinforcement of the connecting groins. At the outside ring the other ends of this reinforcement are attached to the steel vertical girders, thus tying the whole structure right across the reservoir. The groin reinforcement is 3 in. by 11 lb. steel joist, and the groins themselves in which it is embedded are 14 n. wide and project 14 in. below the dome, and are arched on the underside to a radius of 20 ft. 4 in. These groins were molded in place.

The domes have a span between opposing parallel groins of 30 ft. They have a minimum thickness of 6 in. at the crown, increasing to 13 in. at the center of the groins. The intrados is struck to a curve varying from 50 ft. radius at the center to 17 ft. radius at the springing. Double shuttering was not required for this work. Some elaborate tests were carried out on a section of a dome, in the course of the work, with both symmetrical and unsymmetrical loading, the latter including a test load on one-half of the span of 12 tons of bricks, which the section stood with only ¼ in. deflection and no sign of failure.

The centering adopted consisted of triangular scaffolds mounted on wheels. Six scaffolds were placed together between the pillars and on the top was placed the dome centering, consisting of 18 dome sections and a keypiece. This centering proved very portable and was quickly moved and re-set as the progress of the work required.

Of this amazing structure, into which went apparently every kind of material and type of design, "The Engineer" says "it is claimed to be the most economical reservoir in the world," although no comparative figures or competing designs are mentioned. No intimation is given that the design is considered extraordinary.



VIEWS DURING CONSTRUCTION OF CROSS HILL RESERVOIR, BIRKENHEAD, ENG., WATER-SUPPLY

Upper left, I-beam arches tying together the posts, also arched outer walls of brick and concrete; lower left, orange-peel shaped roof forms; right, precast concrete block posts with I-beam groins incased in concrete.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Chance To Help: Books and Instruments Needed at Antioch

Sir—Antioch College needs a great extension to its technical library. I am sure that many other engineers over the country have been in the position in which I have found myself of endeavoring to move about the country and carry along a large accumulation of technical books.

I wish we might have your assistance in making known to the engineering profession our need of a technical library, as doubtless very many engineers would be willing to make a gift of duplicate copies or of libraries they cannot carry with them, or at least would be willing to make and indefinite loan of such books.

We are increasing not only our technical library, but also our supply of general literature. We are putting small alcove libraries on each floor of our two dormitories, so that during his college course the student will be put in close association with good books without having to go through the routine of library procedure. I should be very grateful for any assistance in building up this equipment.

We also find ourselves in need of engineering equipment beyond the limit of our budget. Assistance in supplying some of this would be as helpful as cash contributions to our undertaking.

ARTHUR E. MORGAN,
President, Antioch College.

Yellow Springs, Ohio,
Sept. 19.

Engineering Education and the Engineer's Status Abroad

[*It is an interesting coincidence that each of the following three letters discussing Prof. Burr's paper on engineering education (see "Engineering News-Record," July 14, p. 65) makes reference to the engineer's status abroad.*—EDITOR.]

Sir—Professor Burr's discussion of higher education for engineers is particularly important and valuable to the profession because it represents the conclusions reached by one of its most widely experienced members, and if for no other reason, should be given the serious consideration of all who are in any way interested in its progress.

In previous years it has been the first consideration of those contemplating studying engineering (speaking of the majority), how quickly they can finish the course and get out and earn money. The purely commercial point of view has been too much evident for the good of any profession, and especially if the impression of the public and its attitude toward the engineer is concerned. A better professional spirit no doubt is inculcated through a greater familiarity with those subjects dealing with the political, social and economical progress of humanity. It would bring the engineer closer to the public.

To my mind the physician, lawyer and minister come more closely into contact with the great majority of the people than does the engineer, and furthermore devote more time to matters that are given daily publicity in newspapers and other publications. It is therefore to be expected that they are given greater recognition by society. This may be due not so much to their having been trained in the "higher education" any more so than engineers, for sometimes the contrary appears to be evident, judging from the position taken by some of them on important questions covering the best interests of the public.

The aloofness of engineers in general from association with the lay public in helping to determine public policy and assisting in clarifying the minds of non-technical men in matters that may need at times the benefit of the judgment and imagination of the scientifically trained person, and even in cases where scientific or technical questions are not involved, would continue to keep the engineer in the background so long as that attitude is maintained.

Commercial, governmental, public as well as semi-public officials and committees would welcome the service that engineers could bring into their various deliberations on moot questions and discussions.

It is my belief that the higher cultural training for the engineer would be more apt to create in him a greater interest and understanding of public affairs and greater realization that the interest of the engineer is bound up with that of the public. He will then more frequently finds his place willingly and naturally alongside of men of other professions on directorates of large and small corporations, as heads of large industries, commercial or public organizations, and on their committees. The public in its press would soon recognize the contribution of the engineer to the general public welfare and his lack of recognition by society would no longer be a subject for consideration by the profession.

The lack of a definite constructive policy toward developing and apprenticeship for engineers and skilled labor, is a condition that today underlies a great many of our economic troubles.

In Europe it would be evident to any American engineer visiting there, how different the attitude of the public is toward the technical professions, how much more the engineer and engineering associations are devoted to an interest in public affairs, and how much they assist in formulating policies and activities. The higher cultural education generally of European engineers is perhaps accountable for this.

MAURICE DEUTSCH,
Architect and Engineer.

New York, Aug. 15.

Sir—Engineers, generally, are prone to rail at the public for not according them a proper recognition. The columns of your journal have contained many comments upon this subject by engineers who call attention to the need of educating the public along this line.

Public sentiment on this subject should not be blamed, neither will it change until the term "engineer" has a more definite signification than at present. Just as soon as the interest in civic affairs, the educational attainments, and what may be termed "polish" of engineers as a whole merit it, they will doubtless be accorded by the layman the same high status as lawyers and doctors.

The civil engineer in European countries is regarded by his countrymen as at the top of the professional ladder. The civil engineer in America is accorded by the public more nearly the status of a carpenter. There is, I believe, no other reason for this viewpoint than the fact that in Europe the public is aware the term "engineer" invariably signifies a cultured man of scientific attainments, while all too frequently, in this country, our self-styled "civil engineer" has mental attainments no higher than those of a carpenter. Unfortunately the public mind does not have sufficient opportunity to differentiate properly between the "quack" and the educated man of true technical ability.

Railways, I believe, are by far the largest employers of men engaged in engineering work in this country, and many able engineers are numbered among their employees. Too many, however, of our so-called engineers, employed on railways, are made by the following formula: Add to a preliminary survey party passing through Podunkville, a corner grocer's clerk, ornamented with a red bandana and a pair of high boots, and armed with a bundle of stakes. The following year replace his stakes with level or transit and add a smattering of engineering terms. By the end of the third year, the trick is accomplished. Is it any wonder that the public feels no awe in their presence? These men have a useful place in the world, and if they have grit enough to acquire through their own efforts and study the technical principles of engineering, let all doors be open and all hands extended to them. In the meanwhile, they have no more right to be considered engineers than have hospital attendants to be considered doctors: or law clerks, lawyers.

The greatest need of the engineering profession today in America is a curb upon the present custom of permitting

who so will to call himself an engineer, and open up upon the public. The quickest and most effective way to accomplish this end is that adopted by lawyers and doctors; i. e., requiring a license before a title can be had, or before the practice of the profession can be taken up. The various engineering societies should exert themselves to this end and offer helpful suggestions as to how it can be best brought about.

As a class, engineers are disposed to be diffident and to avoid publicity, as compared with lawyers and doctors. This is to their decided detriment in reaching their proper standing in the community, and is, in large measure, the fault of their college training. Few, if any, of our engineering institutions lay sufficient stress upon the importance of an engineer's ability to write correctly and to speak the English or any other language, or to appear at ease before an audience. In consequence, thousands of otherwise capable engineers feel handicapped, and make a bad impression when participating in public discussions. It is not sufficient that instruction along this line be given in the preparatory schools only, but should be accorded a very definite place, and its importance impressed upon the student throughout his college course.

As to attaining higher technical education, Prof. Burr's suggestions of a strictly technical course, subsequent to that of the college training is unquestionably the correct solution and is in line with the practice of European countries.

F. D. NASH.

St. Louis, Mo., Aug. 23.

Sir—There are two different points in the problem of engineering education which interest the engineering profession and which have to be analyzed separately:

First: More recognition from the public, and

Second: A fair compensation for the services rendered to the community.

The *first* point is attained in Europe (especially on the continent), where an engineer enjoys practically the same social standing as a doctor or a lawyer. There are two principal reasons why engineers do not get in this country the recognition to which they are entitled.

The first reason lies in the denomination "engineer" itself, which is applied both to the professional man and to the man who attends an engine. The number of the "engineers" (manual laborers) being much larger than that of the "engineers" (professional men), how can it be expected that the public has a special recognition for "engineers," when the chances are that the ordinary person, on hearing that "so and so is an engineer" will think of him as a locomotive driver?

This condition does not exist in Europe (except in England), where the professional engineer is called an "ingénieur," whereas the engineer (manual laborer) is called "mécanicien, machinist," etc.

The remedy is obvious, although not easy to apply, and likely to meet with considerable opposition. It would consist in adopting a denomination which contains the root of the original word "ingenium," for instance, "ingeneers" or something similar.

The second reason is to be found in the large proportion of non-graduate engineers in this country. While many of these are excellent engineers and have great achievements to their credit, it is also true that such a condition does not exist in the medical or legal profession, and it will be readily admitted that this influences the opinion of the public for the engineering profession in an unfavorable manner. This condition does not exist in Europe (especially not on the continent) because, almost without exception, engineers are college graduates.

The remedy lies in regulations, registration, etc.

Coming now to the *second* point, which deals with a fair compensation for the services rendered, I find that here there is one aspect of the problem which seems to have been overlooked by all your correspondents so far, and which is in my opinion the most important of all.

From a business point of view, engineering services are but one of the very large variety of wordly goods which are bought and sold. As such, engineering services are subject to the universal law of supply and demand. Large demand and scarce supply, mean high prices and premiums (here adequate salaries) while scarce demand and large supply mean low prices (here insufficient salaries).

It is a recognized fact that the amount of engineers available is too high for the amount of engineering services which the world requires. This is just as true in this country as it is in Europe, where the compensation is therefore also inadequate.

This excess supply of engineers is brought about chiefly by the illusions which many young fellows have as to the conditions of the engineer's life (open air, rapid advancement, recognition, etc.). The real conditions of the engineering profession should be made perfectly clear to the young men, so that such illusions would be abandoned. A real service would thus be given, and much disappointment in life avoided, as many of them would turn to other fields of activity, for which they are very likely better fitted. At the same time, offer and demand of engineering services being more balanced, an improvement in compensation would follow.

A. J. GILARDI,
Civil Engineer.

Jackson, Mich., Aug. 17.

Epes Randolph

Sir—Your journal of September 1, p. 379, carries an appreciative summary of the career of the late Colonel Epes Randolph. His ability and character were so preeminent, his career so striking, that the writer, a friend from the time of his young manhood, begs of you space for further tribute. The article in question outlines the salient engagements of his career, but touches all too lightly on his remarkable qualities of charm, discernment, consideration for others, and, dominating all, judgment of men, and foresight as to future events.

In the late '80's he came into the service of the Chesapeake & Ohio Ry. during the construction of its link from Huntington to Cincinnati, and there attracted the attention of C. P. Huntingdon.

It was while in charge of the line from Louisville to Memphis, that Col. Randolph, from overexertion during a strike, contracted tuberculosis, by which his activity during the remainder of his life was sadly limited.

He was carried to the Southwest, in a desperate condition from which his doctors foresaw small chance for recovery. He spent nearly a year on the edge of the Salton Desert, making recovery to the degree that he could do a certain amount of work. It is well known that it was the intention of Mr. Huntington to place Col. Randolph at the head of the Southern Pacific system, to succeed the then general manager, whose health was failing. In fact the position was informally tendered to him. The disease, however, had so impaired his strength that it was declined, and he accepted the limitations of his condition which compelled residence in the arid land.

The division of the Southern Pacific from Yuma to El Paso was put in his charge with practically a free hand, to manage it according to his own judgment. Just before the death of Mr. Huntington, conditions arose which threatened the construction by well-known copper operators, of a road paralleling a portion of the system. Certain concessions were recommended by Col. Randolph to Mr. Huntington, which probably would have been made had he lived, and should have prevented the construction of that road, which has taken many millions of traffic from the Southern Pacific.

After the death of Mr. Huntington, Col. Randolph resigned from the Southern Pacific, moved to Los Angeles, and undertook the construction, for H. E. Huntington, of the Pacific Electric system of Los Angeles and suburbs. This system was largely, if not chiefly, the vision of Col. Randolph. Under this task, his health again broke down and he returned to Arizona to recuperate.

When the late E. H. Harriman came to study the problems of the Southwest, certain recommendations of policy by Col. Randolph, on file in the New York office, were brought to his attention. He asked who Randolph was,

and bade them invite him to New York. The reply was that his health would not permit. On his next visit to the Southwest, he invited Col. Randolph to meet him and asked him to undertake services for the Southern Pacific system. One was to secure the Cananea Ry., the other to prevent the construction of the Santa Fe system up the Gila River. In both of these he was successful. He was then placed in charge of all the subsidiary lines of Arizona controlled by the Southern Pacific Ry.

About this time the break in the Colorado River occurred. The river turned into the Salton Sink and threatened, unless halted, not only to fill that depression, forcing the Southern Pacific line west of Yuma to a new location above sea level along the foothills, with its saw-tooth profile, but to destroy the possibility of cultivation of the Imperial Valley which even at that time had a large and growing population. The California Development Company threw itself into the hands of the Southern Pacific, as the only organization with power to meet the crisis. Mr. Harriman demanded the property be put in the hands of Col. Randolph, as his representative, and entrusted him with the gigantic task of closing the break.

He made several attempts, resulting in failure. Many engineers, including those of influence in the Southern Pacific system, questioned the possibility of success. Col. Randolph maintained that it could be done, Mr. Harriman almost alone sustained his judgment. The outcome was that, with the help of every quarry on the Southern Pacific system for 300 miles east and west of Yuma, by the use of almost the entire flat car equipment and its bridge and pile-driver staff, Col. Randolph, after his preparations were made and trestles driven, closed, in three days, a stream 1,100 ft. wide, 34 ft. deep in the middle, flowing at the rate of 4½ miles an hour, and turned the Colorado River back into its old channel to the Gulf.

During this time Col. Randolph suffered an attack of his old trouble. One of the dramatic pictures of the engineer's life is that of him, with temperature at 102½, lying in his car on a siding at the end of the trestle, supervising the work until it came to success. It is needless to say that such success still further confirmed Mr. Harriman's confidence in Col. Randolph's judgment.

About this time, a renewed offer was made by the Mexican government to the Southern Pacific to build a line down the west coast of Mexico. This had been Col. Randolph's vision and he advised it. As a result, it was undertaken by Mr. Harriman and has been constructed, save for the gap of less than 100 miles where the Sierras must be climbed from Tepic. It has met a disastrous experience, due to the revolutions of the past ten years, but it holds a domination of the Pacific Coast of that country with which nothing can interfere, and ultimately when stability reaches that troubled land, will be of great value.

These be some of the salient and dramatic episodes in his career. It is almost impossible to picture his human qualities, with the wonderful judgment of men. There was in him at all times a sympathy for those who needed help, which made him sometimes a victim, but which in the aggregate left as his debtors and friends many, many men scattered throughout the whole Southwestern country. He was at no place and at no time without friends at his command. Curious episodes of service rendered to him without even knowledge on his part of whence the favor came, could, but may not, be told.

As the writer in your issue of September 1 has said, the remarkable thing about him is that his great work was done when he was physically impaired. For nearly thirty years he was a weakened victim of tuberculosis, incapable of any continued physical exertion, compelled by his condition to yield the utmost attention to his limitations and yet carrying on with indomitable spirit, and a brain seething with vigor and initiative. He held vision and judgment equalled by few. But for the limitations of body, his field of activity would have been larger, his name would have been known beyond his profession, but he would have left no more cordial friends and no warmer place in the hearts of those who knew him.

St. Louis, Sept. 8, 1921. PHILIP N. MOORE.

Moving a Wireless Tower

Sir—In an article in *Engineering News-Record*, Sept. 8, p. 420, which describes the moving of a wireless tower 200 ft. high at Fort Sam Houston, the writer, Lieut. A. T. Colwell, Corps of Engineers, omitted to mention that the tower was moved by the Construction Service of the Quartermaster Corps on duty at that station.

CONSTRUCTING QUARTERMASTER.

Fort Sam Houston, Texas, Sept. 17.

Wood and Cast-Iron Pipe

Sir—I can readily understand your motive in writing the editorial note, "Wood Water Pipe at Norfolk," in your issue of Sept. 8 but may I not suggest carrying the same idea a little further? "Thoughtless people" might also get the impression from Mr. Ledoux's article that tuberculation is an incurable cast-iron pipe disease and that wood pipe is to be preferred to cast-iron on this account. As a matter of fact, we all know that many waters will not cause tuberculation at all, and even where it does occur it can be remedied by cleaning the main.

Cleaning a water main that becomes tuberculated to such an extent as to seriously interfere with the flow should be part of the regular maintenance work. Furthermore, with the efficient cleaning methods now used, it is hardly fair to figure pipe discharges using a co-efficient for pipe thirty years or more old, since regular cleaning should keep this figure well down toward the ten-year value. While I have no figures at hand as to the cost of the repairs on the Norfolk main, my guess is that it would have paid for several cleanings of cast-iron pipe, and if cast-iron pipe had been used, instead of now having a patched conduit Norfolk would have one in good shape with another hundred years of life still in it. THOMAS F. WOLFE,

Secretary Cast Iron Pipe Publicity Bureau.

Chicago, Ill., Sept. 17.

Plumber or Sanitary Engineer

Sir—I am enclosing an article clipped from a monthly periodical issued by one of the great manufacturing organizations of this country.

It is rather interesting to the engineering—I was going to write "profession," but I am growing more and more in doubt whether there *is* any such *profession*.

Perhaps you may think the article worthy of editorial comment. AN OLD CIVIL ENGINEER.

New York, Sept. 6, 1921.

The enclosure, from *The Valve World*, a house organ of Crane Co., Chicago, is an article by R. Vessey, entitled, "Let's Put It Over." It reads as follows:

"The latest state to adopt the term 'Sanitary Engineer' for plumber is Colorado. We now have Indiana, Tennessee, Minnesota and Colorado. At the latest convention of California Master Plumbers it was suggested to change the name to Domestic Sanitary Engineers, but this did not carry which is very unfortunate. Still, all things require time.

"When I suggested first the term in 1913 in an article which I prepared for the *Plumbers' Trade Journal*, I had set ten years as the time required to 'put it over,' which leaves about two and a half years to go.

"Hundreds of individual plumbers are changing from Plumbers to Sanitary Engineers in every state of the Union and in most cases they are the live wires in their community, real business men with a thought for the future, not only for their business but their families, their social standing and general uplift.

"The peculiar thing to us is that the term has been adopted by progressive states in the West and South but the East lags. Is the East going to allow the West and South to beat it to it? We hope not.

"Let us all get together and put it over 'now.'"

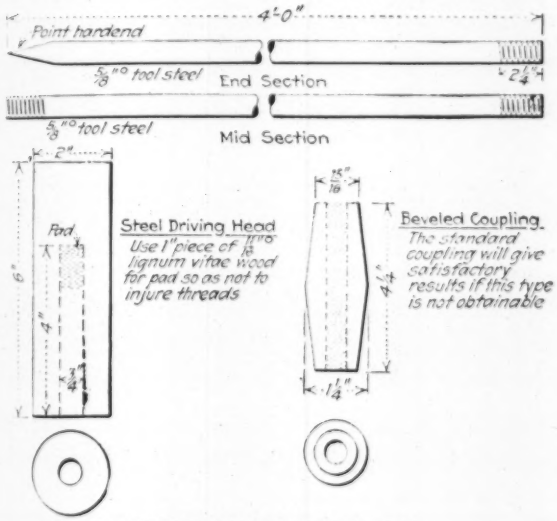
[Our comment will be very brief. It is our judgment that the Federated American Engineering Societies and the national and local engineering societies should bestir themselves and see to it that the plumbers do not "put it over." Otherwise we, the professional engineers, will shortly be nameless.—EDITOR.]

HINTS FOR THE CONTRACTOR

Determining Character of Subsoil With Sounding Rods

By George E. Horr
Construction Department, Turner Construction Company, New York City

WASH borings may give valuable information regarding the nature of the subsoil when soil-bearing footings are contemplated, but the information obtained from such borings is largely negative when rock or pile-bearing footings are in question. The writer knows of one case where seven wash borings made on a building site indicated rock slightly below grade. When excavation was carried to this level it developed that in each case the wash boring had brought



DETAILS OF SOUNDING ROD

up on large boulders. The considerable expense of these borings might have been saved and just as definite information could have been obtained at small cost by using sounding rods.

The information obtained by the use of rods is, of course, also negative, but the small cost of the equipment and the low labor cost of making the soundings seems to warrant more general use of this method for comparatively shallow explorations. Such soundings may often be made to advantage as a preliminary step before deeper borings. When piles are contemplated the results of the soundings will give valuable data regarding the penetrability of the soil and probable lengths of piles required. It is frequently possible to locate sub-surface obstructions which would not permit the driving of piles.

A satisfactory set of rods can be made of ⅝-in. round tool steel consisting of one pointed-end section, as many mid-sections as may be needed to sound the desired depth, couplings, and a driving head, as indicated in the sketch. The only tools required are an 8-lb. sledge hammer, two stillson wrenches, a short piece of chain and a lever to pull the rods. The pointed section of rod is driven into the ground until almost to grade, when a mid-section is coupled on and the driving continued until another mid-section is required. When refusal is obtained, under average blows, the rod is pulled. Another sounding should be made about 4 ft. away to determine if the first might have hit a boulder. If the rod brings up only a few feet below the surface, a test pit should be dug to determine if boulders are obstructing or whether rock has been found.

Two men can make a sounding to the depth of 25 ft., including the pulling of the rods, in about one hour.

Locating Contractors' Equipment

WITH colored thumb-tacks and a blackboard arranged as indicated by the accompanying sketch, the Dravo Contracting Co., Pittsburgh, Pa., keeps a visual equipment-location record which is useful wherever a number of contracts are in progress. A tack of a certain color indicates each type of equipment and a numeral on the tack tells the number of items of the type. These tacks are placed in the "classification" column and indicate the equipment on hand. Similar

Equipment	Classification	Warehouse	Job 127	Job 128	Job 162	Job 141	Job 129
Steamshovels	o o	o o	o		o		
Conc. Hoists	o o	o		o		o	
Buckets	o o o	O o	o o		o O		o
Piledrivers	o o o		o o				o
etc.							
etc.							

BLACKBOARD EQUIPMENT-LOCATION RECORD

tacks in the remaining columns show the distribution. Taking, for example, buckets, the "classification" column shows three types of buckets and the numerals show, say, three of one type and two each of the other types. Two buckets are in the warehouse, one, indicated by a small tack, being in process of repair, and the other, indicated by a large tack, with repairs completed and the bucket ready for shipment. The other buckets are distributed between jobs 127, 162, and 129. On job 162 one bucket, indicated by a large tack, is no longer required and can be transferred to another job. The small tacks indicate the other buckets to be in use.

Fast Pavement Construction in Iowa

Using an industrial railway outfit, 1,020 ft. of concrete pavement, 7 in. thick, at the sides and 8 in. thick in the center, 18 ft. wide was recently completed in 16 hours continuous run on the Lincoln Highway in Clinton County, Iowa. The mixer was kept supplied by one locomotive hauling ten cars to each train. As this portion of the highway is on an approximately 5 per cent down grade, ¼ mile long, another locomotive was kept at the mixer to prevent the cars from getting away on the hill. The average haul from the material yard was one mile. Work was started at 4:30 a.m. and the header board was in and the joint finished by 9:30 p.m., with one hour lay-off, altogether, for meals. The work progressed at the average rate of 64 ft. an hour. The contractor was Koss Construction Co., of Des Moines.

NEWS OF THE WEEK

New York, September 29, 1921

To Aid in Solving Snow Removal Problem

Methods and Equipment Discussed at Forum of American Society of Mechanical Engineers

A wide range of methods and machines for the solution of the snow-removal problem in New York and other cities was introduced at the meeting of the Material-Handling Section of the American Society of Mechanical Engineers in New York, Sept. 23, following a presentation of the facts in the case from the point of view of the city official by John P. Leo and John T. Fetherston, commissioner and ex-commissioner, respectively, of the New York Department of Street Cleaning, and John Kenlon, chief of the Fire Department. The meeting, at which Nathan C. Johnson presided, was the outgrowth of a recommendation for a forum on snow removal, made after last February's severe storm by Henry L. Doherty.

The discussion centered on various snow-removal devices, including mechanical loaders of the conveyor type, rotary plows adapted to municipal operations from the experience of Western railroads, and snow-melting devices.

Possibilities in Briquetting

A number of speakers presented plans for the briquetting of snow, the object being to reduce its volume about nine-tenths, thus enabling the material to be piled along the street so as to occupy a comparatively small area, or loaded into trucks which could, with loads of briquetted snow, more nearly operate at their ratio carrying capacities than is possible with loose snow. Mr. Doherty expressed confidence in the development of some practical scheme of briquetting snow and it was brought out in the discussion that a device of this sort had been developed 40 years ago by Thomas A. Edison.

The problem of city snow removal was tersely stated by former commissioner Fetherston when he said that answers are needed to the following three fundamental questions: (1) For what depth of fall, density, rate duration, and occurrence of snow shall the city reasonably prepare each winter? (2) What are the allowable maximums for the design of the organization and apparatus? (3) How many hours or days should reasonably be allowed for the removal of snow from the scheduled area, meantime keeping the streets free for the movement of traffic in order that the citizens of the town may judge, reasonably, of the efficiency of the organization, methods, procedure, management and apparatus?

The following data regarding snow in New York City were presented: The average annual snowfall amounts to 32 in. The weight of newly fallen snow varies from 6 to 30 lb. per cubic foot; compacted snow weighs from 30 to 50 lb. per cubic foot. Average snow loaded in trucks weighs 36 lb. per cubic foot. The maximum rate of snowfall is about 1 in. per hour and the average rate ½ in. per hour. The snowstorms of longest duration seldom exceed 30 hr. Between 1905 and 1914 the greatest single snowstorm had a depth of 14.5 in. In 1917-18 the New York Street Cleaning Department scheduled for snow removal 953 miles of streets with an area of 33,537,577 sq.yd. equal to a roadway 60 ft. wide extending from New York to Chicago. A 6-in. fall on this area deposits 5,500,000 cu.yd.

Fetherston's Recommendations

The following recommendations were made by Mr. Fetherston as a means of solving the snow problem: (1) Set up standards of quantity, quality, time and conditions as a basis for the design of organization, methods, procedure and equipment. (2) Provide personnel and apparatus to meet the conditions, and make the work attractive to available forces by offering pay commensurate with work and the results secured. (3) Assure long tenure of office to competent city officials. There have been 11 commissioners of street cleaning in New York City in 23 years.

The meeting concluded with the passage of a resolution authorizing the council of the American Society of Mechanical Engineers to appoint a committee of its members to co-operate with city officials on the snow-removal problem and the development of mechanical apparatus therefor.

Memphis Club Favors Commissions for Sanitary Engineers

The Engineers' Club of Memphis has passed resolutions endorsing the bill now before Congress to commission sanitary engineers in the United States Public Health Service (H.R. 7541), noted in this journal, Aug. 18, p. 26.

Illinois Wants Bids on 61 Bridges

Bids will be received up to Oct. 4 for the construction of 61 bridges, involving 109 concrete and 8 steel spans, which compose the 1922 state bond issue bridge program of the Illinois Division of Highways. Three of the projects, only, are scheduled to be completed this year.

Calaveras Dam to Be Raised to Height of 175 Ft.

Work on the Calaveras dam of the Spring Valley Water Co. in California has recently been resumed in accordance with an order of the California Railroad Commission. At its present height of 85 ft. the dam stores 8,000,000,000 gal.; when raised to 175 ft. it will impound 43,000,000,000 gal. and will increase the available daily supply of San Francisco by 24,000,000 gal. The present work is of a preparatory nature. The method to be used in handling and depositing the material has not yet been decided.

No Danger of Settlement of Lincoln Memorial

Published reports that the Lincoln memorial at Washington, D. C., is threatened by subsidence are denied emphatically by Colonel C. O. Sherrill, in charge of public buildings and grounds. Colonel Sherrill states that there has been no difficulty whatever with the memorial itself. It rests on concrete piles, which were carried down 50 ft. to bed rock. The entire area occupied by the monument and grounds was filled hydraulically. The land had not consolidated completely at the time the memorial was erected and in an effort to keep within the appropriation, the foundations of the approaches to the monument were not carried to bed rock. After their completion, settlement was noticed and work now is in progress to extend their foundations to a permanent stratum.

Tractive Resistance Data Wanted

The committee on economic theory of highway improvement of the National Research Council, through Major Mark L. Ireland, Quartermaster Corps, U. S. Army, has sent out a request for data on the tractive resistance of roads. Bibliographies or experimental data on the following subjects are desired: Tractive resistance of roads; manner of energy absorption in motor vehicles; gasoline consumption of various vehicles on various roads; scientific testing of automobiles; economics of highway transportation.

The research, which is to be undertaken through a combination of War Department interests and those of the Massachusetts Institute of Technology, will be confined, for the present, to determining the tractive resistance of concrete surfaced highways to 1½ and 3-ton gasoline trucks. Information may be sent to Major Ireland, c/o Electrical Engineering Department, Massachusetts Institute of Technology, Cambridge, Mass.

Milwaukee To Ask Bids on Activated Sludge Plant

Plans to Award Lump-Sum Contract for Sewage Works in December

Proposals for building the concrete aeration and sedimentation tanks for the activated-sludge sewage disposal plant now being constructed by the Sewerage Commission of Milwaukee will be asked soon with the expectation of awarding contracts in December.

As planned the work consists of 24 aeration tanks, 237 ft. 8 in. long, 45 ft. wide and 16 ft. 7 in. deep; 11 sedimentation tanks 98 ft. in diameter and 16 ft. deep, and 4 sedimentation tanks 43 ft. 4 in. in diameter and 16 ft. deep, all of reinforced concrete. There will also be 1,440 lin.ft. of pipe galleries 17 ft. wide by 13 ft. high, of brick construction, and conduits, piping, sluice gates, valves, meters and miscellaneous equipment. About 5,000 tons of steel reinforcing rods; 62,000 cu.yd. of concrete; 80,000 filtros diffusion plates, and 42 meters will be used on the work, together with a large quantity of cast-iron pipe, from 66 in. to 10 in. in diameter, and galvanized-iron pipe and fittings, from 2 in. to 1 in. in diameter.

LUMP-SUM BASIS

The work is to be done on the lump sum basis, the Sewerage Commission furnishing the steel, cement, brick, cast-iron pipe, meters, valves and sluice gates. Pile foundations have been provided for the tanks so that the preliminary preparation work is largely eliminated.

All plans have been prepared with a view of simplifying construction by means of uniform concrete forms, so far as these may be possible. Railways and boats reach the site of the work, which is so located as to be free from all municipal transportation difficulties.

At the present time contracts amounting to $2,233,600 have been awarded for the disposal plant construction, and, including the work described above and other work to be contracted during the next 18 months, this sum will be increased about $5,000,000. T. Chalkley Hatton is chief engineer.

Engineer Registration Board for Pennsylvania Appointed

Governor Sproul, of Pennsylvania, on Aug. 24, announced the following appointments to the state board for the registration of professional engineers and land surveyors: Richard L. Humphrey, consulting engineer, Philadelphia; Henry S. Drinker, Lehigh University, South Bethlehem; William McClellan, consulting engineer, Philadelphia; A. B. Clemens, International Correspondence Schools, Scranton; Samuel D. Foster, consulting highway engineer, Pittsburgh. In the order above named the new members of the board will serve respectively 5, 4, 3, 2, and 1 years.

National Drainage Congress Meets in St. Paul

At the tenth annual meeting of the National Drainage Congress, held in St. Paul, Minn., Sept. 22-24, resolutions were passed urging more adequate state protection of settlers on reclaimed lands and the improvement and simplification of state laws affecting drainage and other forms of reclamation.

Dr. F. H. Newell, of Washington, D. C., in an address on colonization of reclaimed lands, stated that while many millions of dollars have been spent for reclaiming lands by drainage, irrigation and clearing, the most fundamental activity of all, that of properly selecting and caring for settlers, is still shamefully neglected.

Clark E. Jacoby, of Kansas City, Mo., newly elected president of the organization, advocated reclaiming through private enterprise, instead of state or federal aid.

If artificial drainage of swamp lands in Minnesota is continued, said J. N. Ryker, government meteorologist, the Mississippi River will soon lose most of its value for navigation unless locks and dams are installed at intervals to control the water.

Drainage projects, by carrying off water from the subsoil and natural reservoirs, prevent the ground from holding water and giving it off gradually, according to Mr. Ryker. The result is that rains are carried off into streams at once, causing abnormal floods for the time being, and abnormally low water afterwards.

Drainage experts attending the congress did not deny the truth of Mr. Ryker's statements, but held to the theory that the benefits resulting from drainage outweigh the damages.

Fall Letting of Highway Contracts for New York State

THE principle of letting contracts for the 1922 highway program this fall has been accepted by the New York State Commission of Highways. "Engineering News-Record" has received from Commissioner Herbert S. Sisson the following official statement of policy:

"I have your letter of the 19th. We expect to let something less than 50 per cent of the contracts for highway construction during the season of 1922 this Fall. We would be glad to to contract for the full construction program for next season as soon as possible, but owing to the fact that no appropriations are available for at least 50 per cent of the work to be done next year, we must wait until the Legislature makes an appropriation necessary for construction work. Our Legislature convenes on or about Jan. 1, and I believe will provide funds for highway construction very early in the session.

"We hope to be in a position to contract for our entire 1922 program on or before May 15."

Col. Keller Heads Capital's Engineering Department

Succeeds Col. Kutz as Engineer-Commissioner of District of Columbia

Col. Charles Keller, Corps of Engineers, U. S. Army, has been appointed by the President, acting upon the recommendation of Major-Gen. Lansing H. Beach, Chief of Engineers, to be engineer-commissioner of the District of Columbia, succeeding Col. Charles W. Kutz. The duties of this position are practically those of city engineer, in addition to participation in administering the affairs of the district as a member of the board of three commissioners. Col. Keller's most recent detail has been in the office of the Chief of Engineers at Washington, where he has devoted a considerable part of his time to studies of port and waterway problems, having served, also, as a member of the War Department's board of engineers for rivers and harbors. During the World War he served in France, with rank of brigadier-general, as assistant to Major-Gen. William C. Langfitt, chief engineer, A. E. F., being station first at Tours and later at General Headquarters at Chaumont, where he acted as the chief engineer's representative in relations with the General Staff. He is generally regarded as one of the ablest engineering executives in the Corps.

Col. Keller is a native of New York and was graduated from the U. S. Military Academy in 1890. He has filled many important engineering positions with the Corps of Engineers in this country, in addition to his service in the Philippines and in France. During the last two years he has represented the State Department in negotiations with the Canadian Government regarding boundary waters. He is a holder of the Distinguished Service Medal and was decorated by the French Government with the Legion of Honor. His citation for the Distinguished Service Medal reads as follows:

"For exceptionally meritorious and distinguished service. As assistant to the Chief of Engineers, U. S. Army, he was instrumental in initiating policies which protected the channels and anchorages of our important harbors from observation by enemy aliens. As power administrator on behalf of the United States he organized the Power Section of the War Industries Board and initiated measures as a result of which the war program of the country was successfully protected against serious delay due to power shortage."

Cantilever Bridge for Australia

The cantilever bridge which is proposed to span the neck of the harbor at Sydney, New South Wales, is to have a span of 1,600 ft. c. to c. of piers, according to a statement issued by the Harbor Trust Commissioners. Both cantilever and anchor arms will be 500 ft. long, the former carrying a 600-ft. suspended span. A clear head room of 140 ft. above the water will be provided. There will be four tracks for electric suburban trains, a 35-ft. roadway for ordinary vehicles, and 18-ft. roadway for automobiles and a 15-ft. sidewalk. The maximum live load will be equivalent to about 11,000 tons. This bridge in relation to the rapid-transit system of the city of Sydney was described in *Engineering News-Record*, July 8, 1920, p. 56.

F. T. Sheets Named Head of Illinois Highways

New Executive, 31 Years Old, Started Work With Department in 1907 as Engineering Clerk

Frank T. Sheets, until recently engineer of design in the Division of Highways, Illinois Department of Public Works, has been promoted, through appointment by the Governor, to the position of superintendent of highways formerly held by S. E. Bradt, who has resigned to devote his time to private interests in DeKalb. At the age of 31 Mr. Sheets thus becomes the administrative head of the state highway organization which has already completed more than 1,200 miles of high type pavement and is finishing its connected system of state roads, with a bond issue program of $60,000,000 to be carried out.

Following his graduation from the University of Illinois in 1914, Mr. Sheets was appointed assistant engineer in the Illinois State Highway Department, with which he had previously been connected in various subordinate engineering capacities prior to his entry into college and during his summer vacations. Mr. Sheets has come up through the ranks to his present position, having started work with the department in 1907 as an engineering clerk. Since that time his duties have related to practically every feature of state highway engineering, including surveys, design of reinforced-concrete and steel bridges, superintendance of day labor and maintenance. Since June, 1919, in his capacity of engineer of design, Mr. Sheets has supervised the work of the offices of road engineer, bridge engineer, and nine district engineers of the highway division on location, surveys, plans, estimates, specifications and contracts for work amounting to about $35,000,000.

Changes Affecting Organization Made by A. G. C.

Several changes affecting the organization of the Associated General Contractors of America were made by the executive board at the recent meeting at White Sulphur Springs, W. Va.

The revisions provide among other features, for: (1) Membership through local chapters; (2) state or construction area divisions to be known as "branches"; (3) a new schedule of dues favoring the contractor doing an annual business of less than $500,000; (4) an increase of the board of directors from 12 to 19 and election by territory.

In addition to these resolutions, the board recommended that the committee on organization take under advisement a plan creating a junior membership with limited privileges, which would include general contractors not now eligible for membership in the A. G. C., and superintendents.

Metropolitan Water District for Twin Cities Opposed

Opposing the proposal to form a metropolitan water district for Minneapolis and St. Paul, John W. Kelsey, general superintendent, Bureau of Water, St. Paul, in the September *Bulletin* of the Minnesota Federation of Architectural and Engineering Societies, concludes that since both cities must obtain their water from the Mississippi River there is little economic or physical reason for combining the two systems.

St. Paul plans to tap the Mississippi River four and a half miles north of the Minneapolis intake and pump water by conduit to Charles Lake, a tributary to Pleasant Lake, one of the existing impounding reservoirs. This scheme eliminates duplicate conduit and pumping machinery and also makes use of the lakes as a sedimentation basins.

City Classification an Issue in Appeal for Road Funds

Of direct interest to smaller cities of the state of Washington and to all others in relation to apportionment of state highway maintenance funds within the corporate limits of first and second class cities, is a recent decision of the Supreme Court that third-class cities do not automatically become second-class cities simply by adopting the commission form of government. Further compliance with statutory procedure is necessary in the holding of an election and completion of all formal requirements involving the transfer of classification.

The ruling is made in denial of a writ of mandate petitioned for by the city to Yakima to compel the state auditor to apportion that city $500 per mile for highway maintenance, under the maintenance statute, instead of $300 as fixed for third class city apportionment. Yakima relied upon its adoption of commission government for its admission into second-class rating and the consequent $500 apportionment.

Roadmasters and Engineers Talk on Track

Budget System for Maintenance Work—Economy of Treated Ties—Curve Lining

Real discussions in which many members described their own methods and expressed opinions freely featured the annual meeting of the Roadmasters and Maintenance of Way Association, held in Chicago Sept. 20 to 23, W. P. Wiltsee, assistant engineer, Norfolk & Western R.R., presiding. C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry., strongly advocated the budget system in distributing appropriations for track maintenance, classifications of work and records of unit costs.

Tie Service Records

Records covering thousands of ties in many states, presented by J. H. Waterman, superintendent of timber preservation, C., B. & Q. R.R., show that where from 1 to 20 per cent of treated ties have been removed on account of decay, the renewals of untreated ties of the same woods have been from 70 to 100 per cent. Where certain untreated ties had a life of from 2 to 6 years, treated ties of the same wood are still in use after 20 years' service. For tie renewals a force of eight men or less is preferable to a large gang, according to the report of a committee headed by E. P. Hawkins, division engineer, Missouri Pacific R.R.

Track crossings with single-piece castings of manganese steel and having a concrete slab allowing for 8 to 10 in. of ballast were recommended for heavy-traffic main lines in a report by D. O'Hern, E., J. & E. R.R. Longitudinal plates under rails carrying the heavier traffic were considered preferable to corner plates under rail intersections, as the latter interfere with proper tamping.

String Lining for Curves

Different methods of string lining for curves, in order to take out irregularities, were submitted by H. L. Pierce, supervisor, Pennsylvania R.R. His address was accompanied by tables showing the amounts of throw required at different points to move the curve in and out to its true position. As a result of investigation the Pennsylvania R.R. has adopted a rule that the alignment of curves should be maintained by means of the string method. Classification and distribution of second-hand rail was reported on by a committee headed by L. E. Sale, supervisor, Pennsylvania R.R. Reports and accounts for the roadmaster's office were presented by F. J. Meyer, assistant engineer of the N. Y., O. & W. R.R.

The new president is L. M. Denney, supervisor of the C., C., C. & L. Ry. at Indianapolis, Ind. It was voted to hold the next annual meeting of the associatoin in Cleveland, the date to be announced later.

To Visit Sanitary Works in and Near New York City

Inspections of various sanitary engineering works in and near New York City, together with addresses on water-supply, sewage and garbage disposal, are a part of the program of the Public Health Institute, Nov. 8-12, the week preceding the fiftieth annual convention of the American Public Health Association in New York City. Opportunities to gain information in other fields of public health work will also be afforded by the Institute. Enrolments, open to non-members as well as members of the A. P. H. A., may be made with Dr. H. B. Armstrong, director of the Institute, 370 Seventh Ave., New York City. An enrolling fee of not more than $10 will be charged. Kenneth Allen, sanitary engineer, Board of Estimate and Apportionment, New York City, is chairman of the Institute's committee on sanitary engineering.

Bar Association Favors Increased Pay for Patent Office Force

At the recent meeting of the American Bar Association in Cincinnati, substantial salary increases for examiners in the U. S. Patent Office were recommended. Resignations of a large number of experienced examiners are due solely, it was claimed, to the present insufficient salaries. To meet the increased cost the association recommended raising the fee for filing applications for patents from $15 to $20.

No Reduction in Canadian Freight Rates for Present

The Canadian Board of Railway Commissioners has decided that there will be no general reduction of freight-rates at present. Two reports, one by Chief Commisisoner Carvell and Commissoner Nantel, recommended a general reduction of 10 per cent, except in cases where the rates had been already lowered. The majority report of the three other members of the board opposed any reduction at present, since the question of wage decreases is the pivotal one in considering a lowering of operating cost. As the wage question is now under investigation by a special tribunal, the railroad commission does not feel justified in recommending a reduction in freight rates.

N. J. Publishes Highway Bulletin

The New Jersey State Highway Department has begun the publication of a monthly bulletin, named "The Highwayman." Its object is to "build up the double-barreled spirit of co-operation and healthy competition within the department" and to keep the public informed of the state's road building activities. The first issue is a four-page illustrated folder, with an insert listing the detours adopted by the department July 6. Its contents includes biographical sketches of Thomas J. Wasser, state highway engineer, and George L. Burton, chairman of the commission.

Rainfall and Runoff Is Subject of Am. Soc. C. E. Meeting

Rainfall and runoff has been selected as the subject for the next regular business meeting of the American Society of Civil Engineers to be held at the Engineering Societies' Building, New York City, Oct. 5, at 8 p. m. The discussion will be upon papers published in the September Proceedings, including "Rainfall and Runoff," by C. E. Grunsky; "The Flood of June, 1921, in the Arkansas River at Pueblo, Colo., by James Munn and J. L. Savage; and "The Recent Flood at San Antonio, Tex.," by C. Terrell Barnett.

The result of the ballot on proposed amendments to the constitution of the society will be canvassed at this meeting.

To Reconsider Highway Bill

The first meeting of the conferees of the Senate and of the House of Representatives to take up the reconciliation of the differences between the highway bill passed by the House and that passed by the Senate will be held during the week of Oct. 3.

Grand Trunk Stocks Worthless, Arbiters Declare

None of the issues of the common and preferred stock of the Grand Trunk Ry. and the Grand Trunk Pacific is of any value, according to the opinion of the majority of the Grand Trunk arbitration board in its decision given out at Ottawa, Sept. 7.

The majority report charges that dividends were declared and paid but not earned, such moneys in reality being due for claims owed the government. It is held that this has destroyed "any value to be derived from stock market quotations."

The decision involves stock issues of par value aggregating £37,073,492. It is expected that the railroad will exercise its right of appeal.

Propose Water-Rail Terminal in Gulf of California

A party of railroad and harbor engineers, accompanied by divers, have been engaged in making a study of a proposed rail and water terminal at Rocky Point in the northwestern portion of St. George's bay, Gulf of California, which is about 100 miles north of Guaymas, according to reports received at San Francisco from the American Consul at Guaymas, Sonora, Mexico. A terminal at this point, if served by an extension from the present terminus of the Tucson, Cornelia & Gila Bend R.R. at Ajo, Ariz., would provide a much needed western outlet for products of Arizona copper mines. The proposed tidewater terminal at Rocky Point would be only 105 miles from Ajo and it is claimed that a railroad could be located over this distance with a grade of less than 1 per cent.

Col. Patrick New Chief of Army Air Service

Engineer Officer, With Distinguished Service Record in France, to Be Major-General

Col. Mason M. Patrick, Corps of Engineers, U. S. Army, who, during the war, was chief of the Air Service of the A. E. F., has been selected by the Secretary of War to be director of the Army Air Service, with rank of major-general which he had previously held in France.

Gen. Patrick was graduated from the U. S. Military Academy in 1886 and, prior to the war, served on several important assignments as engineer of river and harbor projects and as commandant of the Engineer School at Washington Barracks. He was chief engineer of the army of Cuban pacification, 1906-8, and served in the Brownsville district in 1916. Gen. Patrick was a member of the engineer board which was charged with the raising of the battleship "Maine" in Havana harbor, a work which involved the construction of a huge cofferdam made up of earth-filled cylinders of steel sheet-piling.

The War Department has issued an official statement regarding Gen. Patrick's appointment from which the following extracts are taken: "Gen. Patrick is selected for this important position by reason of the special qualifications for it which he demonstrated as chief of the Air Service of the A. E. F. and because of the exceptional ability as an executive and organizer which he has shown in other important capacities."

Prior to his assignment to the Air Service in France, Gen. Patrick served with distinction as the chief engineer of the line of communication and later as director of the Division of Construction and Forestry, a post in which he was succeeded by Brig.-Gen. Edgar Jadwin. At the time of the armistice Gen. Patrick had under his direction a personnel of about 78,000 men. Among his prominent achievements in France was the development of the great air service production center at Romorantin. He received the Distinguished Service Medal and a number of citations from foreign governments, including the French Legion of Honor and the Order of the British Empire. Gen. Patrick's most recent detail has been in command of the Engineers School at Camp Humphreys, Va.

Am. Soc. C. E. Has 10,115 Members

The total membership of the American Society of Civil Engineers on Aug. 2 was 10,115.

A. G. C. Upholds Awards Board

A resolution was passed at the mid-year meeting of the executive board of the Associated General Contractors of America upholding the action of the National Board for Jurisdictional Awards regarding hollow metal doors and trim, and hollow metal window frames and sash, a decision which was taken exception to by the brotherhood of carpenters. The attitude of the carpenters in not adhering to the award board's ruling has been condemned by the A. G. C. in resolution form. It is investigating the possibility of initiating legal action against the carpenters or its members in connection with the actions in disturbing the building industry on account of the above-referred-to award.

H. G. Shirley Heads A. A. A. Good Roads Board

Henry G. Shirley, county engineer of Baltimore County, Md., and until recently secretary of the Federal Highway Council, Washington, D. C., was appointed last week chairman of the good roads board of the American Automobile Association, succeeding George C. Diehl, who recently became president of that organization.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

The Cleveland Engineering Society at its meeting, Oct. 11, will be addressed by D. C. Wills, chairman Board, Federal Reserve Bank, on "Prices—Past, Present and Future."

The California Section, American Water-works Association, will hold its annual convention in Los Angeles Oct. 1 and 2. The morning and afternoon of the first day, Saturday, will be devoted to papers and discussions. The annual dinner will be held Saturday night and will be followed by a paper by William Mulholland, chief engineer of the Los Angeles Water Department on "The Los Angeles Water Supply and Distribution." On Sunday there will be an all-day automobile trip to points of interest on the Los Angeles water system.

The Oklahoma Section, Am. Soc. C. E. will hold its annual meeting in Oklahoma City, Oct. 26-27, in connection with the annual meeting of the Oklahoma Society of Engineers and the State Engineering Council.

Personal Notes

J. B. BENNETT, has been appointed county engineer, Pottawatomie County, Okla.

S. E. BRADT, superintendent of highways, Division of Highways of the Illinois Department of Public Works and Buildings has resigned after eight years' service. During this period the good roads movement has been put on a sound financial basis largely through the efforts of Mr. Bradt, who is a banker from DeKalb.

FRANK T. SHEETS, engineer of design, Illinois Division of Highways, has been made superintendent of highways, succeeding S. E. Bradt, resigned. Further details regarding Mr. Sheets' service with the department appear elsewhere in this issue.

OSCAR E. BRENOT, formerly with the engineering bureau, Pennsylvania Highway Department, has formed a partnership with Joseph Brenot, architect, Oil City, Pa.

F. W. ULLINS, JR., city engineer of Shorewood, Wis., has been appointed the third member of the Metropolitan Sewerage Commission of Milwaukee County. The other members are Charles B. Perry and George P. Miller.

SMITH & REYNOLDS, formerly Juul, Smith & Reynolds of Sheboygan, Wis., have opened an architectural and engineering office in Manitowoc, Wis. Edward A. Juul will continue the business formerly conducted by the firm in Sheboygan.

D. WALTER MUNN, head of the department of engineering at Royal Military College, Kingston, Ont., has resigned to become professor of engineering at Nova Scotia Technical College, Halifax, N. S.

GEERT BLAAUW has accepted a position with the Alabama Power Co., Birmingham, Ala., in connection with the design of a 120,000-hp. hydro-electric plant to be constructed on the Coosa River near Duncan Riffles.

A. M. OCKERBLAD, for the past two years professor of civil engineering in the New Mexico School of Mines, at Socorro, N. Mex., has been appointed assistant professor of civil engineering, University of Kansas, Lawrence, Kan.

JOSEPH M. SMOOT, formerly designer and draftsman in the construction department of the Stonega Coke & Coal Co., Big Stone Gap, Va., has been appointed aid with the U. S. Coast and Geodetic Survey and is now located in Wisconsin.

PITTMAN-SMITH ENGINEERING CO., Pittsburgh, Pa., was recently organized by E. W. Pittman and H. P. Smith to engage in the design of power plants, machinery layouts and all types of industrial buildings. Mr. Pittman and Mr. Smith were formerly general manager and chief engineer, respectively, for the engineering works department of the Dravo Contracting Co.

EDWARD C. SCHMIDT, associate professor of railway engineering at the University of Illinois for 11 years up to 1917, when he resigned to enter military service as major, Ordnance Department, has been appointed professor of railway engineering and head of that department. From 1919 to the present time he has been mechanical engineer for the North American Co.

HARRY G. COUTTS, formerly superintendent for John Griffiths & Son Co., Chicago, is now superintendent for the Longacre Engineering & Construction Co., Chicago, on the new Harris-Selwyn theaters, Chicago.

DANIEL L. TURNER, consulting engineer to the New York Transit Commission, formerly chief engineer of the Transit Construction Commission, New York, in charge of the design and construction of the subway system, and associated for 21 years with the development and construction of the New York subway system, has announced his intention of engaging in private consulting practice, specializing in city transit work, in addition to his present duties with the commission.

S. M. MERCIER, formerly engineer for the Columbus branch of the Building Products Co., has been given charge of the Dayton, Ohio, branch of this company.

E. E. TRUEBLOOD, for 15 years engineer with the Missouri Valley Bridge & Iron Co., has been appointed county engineer, Douglas County, Kan.

H. R. HOLMES, at one time engineer with the New York State Highway Commission, has been appointed city engineer of Lockport, N. Y.

H. B. TITCOMB has been elected president of the Southern Pacific R.R. of Mexico, succeeding the late Colonel Epes Randolph. For several years Mr. Titcomb has been in charge of the Pacific Electric Railway system in Los Angeles with the title of vice-president. Previous to that he was for many years in the engineering department of the Southern Pacific R.R. Co.

Obituary

FRANK E. PATTON, secretary and treasurer of the T. J. Lane Equipment Co., Springfield, Ohio, since its organization, died Aug. 21.

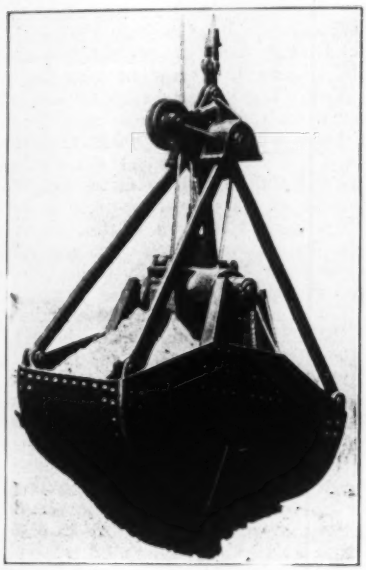
HENRY J. KIMMAN, since 1902 manager of the Cleveland plant of the Chicago Pneumatic Tool Co., died in Cleveland, Sept. 7. He was born in Harlem, Holland, in 1863, and went to Chicago in 1870. He served with the Adams-Westlake Co. and other manufacturing concerns in Chicago and the Far West. He designed and, in collaboration with his brother, built the first practical portable piston air drill

known as the Little Giant. Soon after engaging in the manufacture of air drills he became associated with E. N. Hurley and they formed the Standard Pneumatic Tool Co. in 1898. He became associated with the Chicago Pneumatic Tool Co. in the consolidation of pneumatic tool interests in 1901, at which time he became manager of the Cleveland plant and remained in charge of the plant until his death.

EQUIPMENT AND MATERIALS

New Clamshell Bucket

The Brown Hosting Machinery Co., of Cleveland, is putting on the market a line of clamshell buckets made in ¾, 1, 1½ and 2-yd. sizes. They are equipped with manganese steel digging edges

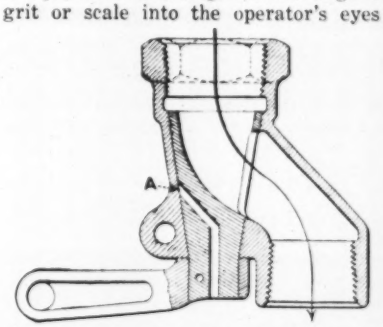


which can easily be replaced when worn. One of the features of the design is that it has few parts and that these are easily accessible so that repairs can be made on the job when necessary.

The company has for a great many years been building large capacity buckets, up to 15 to 20 tons capacity, for use in connection with ore-unloading machinery, bridge cranes, etc., and this experience has been called upon in the design of the new bucket.

Pressure-Seated Air Valve

In this valve, made for general air service, two features are emphasized by the manufacturers: (1) The air does not come in contact with the valve seat—thus avoiding replacement of seat—while (2) the air pressure itself is used as a seating agent to hold the valve plug on its seat—thus eliminating packing, gaskets, stems, and spring. The valve parts are reduced to three—body, plug, and handle. The design is shown in the accompanying sketch. The plug is hollow and the air thus has an unobstructed passage. The air port *A*, when the valve is closed, allows the air trapped in the hose to escape, thus avoiding the blowing of grit or scale into the operator's eyes



when disconnecting the hose from the valve.

The manufacturers, the Cleveland Pneumatic Tool Co., of Cleveland, Ohio, report successful use in severe service under pressures as high as 500 lb.

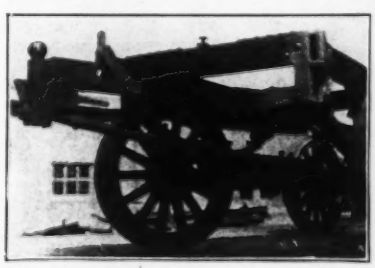
Power Stump Saw

This power stump saw has been developed for use chiefly in those sections where the value of the land is too low

to warrant the cost of blowing out the stumps or where the use of explosives is undesirable. It cuts close to the ground. The device is mounted on a sled frame, and the platform revolves so that the saw is readily fed through the stump. The machine is built by the Hamilton Stump Saw Co., of Harrisburg, Ark.

New Four-Wheel Trailer Tracks Properly with Trucks

Unusually complete control, from the truck, of four-wheel trailers, is secured by the draw bar and steering arrangement illustrated. By means



of the long steering arm the trailer is kept always in the path of the truck. In addition, control in backing and turning is improved by providing for the attachment of the steering arrangement to the drawbar, when the trailer moves forward, and with the axle, in a locked central position, when it is backed up; also when backing up, the front wheels of the trailer are locked at right angles to the axle, while the drawbar is disconnected from the steering arrangement and receives nothing but the rearward push of the truck for the purpose of moving the trailer backward.

The trailer is manufactured by the Warner Manufacturing Co., of Beloit, Wis.

Tram System for Window Washing

At the new Division St. pumping station of the Cleveland water-works a tram system is provided for safe and economical washing of the very large window area.

As is indicated in the illustration, a rail is carried around the building

under the cornice and on this is operated a light hand-propelled tram supporting a cage which can be raised and lowered by two small hand winches. The absence of heavy supports bracings, and rods renders the construction inconspicuous, so that it does not detract from the appearance of the building.

It is estimated that with this outfit three men can clean the windows in twelve days, two men being in the cage and the third bringing water and otherwise attending the window washers. At the rate of 60c. an hour the cost for the entire job would figure $172.80, whereas with the use of scaffolding it is estimated that the cost would be about $800.

The installation can also be used for painting window frames and spouting, and for other light exterior repair work.

The installation was put in by the Electric Tram Rail Division of the Cleveland Crane & Engineering Co., of Wickliffe, Ohio.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Public Bond Sales of July and August

To give a line on how much communities must pay for money for public improvements *Engineering News-Record* will publish regularly in the second issue of each month a representative list of bond sales throughout the United States. Just now, bond sales are exceptionally heavy, the total for July being $103,299,831, and for August $106,291,852, according to the *Chronicle*. Sales for August 1920 and 1913 were $59,684,048 and $19,822,191, respectively. The following partial list of actual sales sketches the general situation:

PUBLIC BOND SALES OF JULY AND AUGUST, 1921

State	Purpose	Amount	Maturity	Rate per Cent	Sold for	Dated
Oregon	Highway	$2,000,000	1926–1946	5½	$100.147	Aug. 1, 1921
Maine	Bridge and highway	1,750,000	$100,000 (1927–31) $125,000 (1932–41)	5	98.147	Aug. 1, 1921
Wyoming	Highway	1,800,000	1931–1941	5	100.00	Sept. 1, 1921
Michigan	Highway	3,000,000	1922	6	100.00	July 1, 1921
Washington	Highway	3,000,000	1926–1940	6	101.538	July 6, 1921
Delaware	Highway	600,000	1961	4½	$300,000 –90.00 300,000– 87.27	Jan. 1, 1921
County						
Defiance, Ohio	Road	292,000	1922–1930	6	100.00	June 1, 1921
Pennington, S. Dak	Courthouse and jail	500,000	1941	6	100.00	July 1, 1921
Polk, Neb	Courthouse	175,000	1926–1936	5½	99.148	Jan. 1, 1921
Lawrence, Pa	Highway	400,000	1922–1936	5½	100.419	July 1, 1921
St. Charles, Mo	Road	200,000		5	95.23	
San Joaquin, Cal	Reclamation	55,950		6	97.50	July 1, 1920
Sumter, Ala	Road and bridge	75,000	1950	5	80.00	Feb. 1, 1971
Wyoming, N. Y	Highway	176,000	1923–1944	5½	100.683	Aug. 1, 1921
Columbia, Fla	Road	100,000	1922–1947	5	90.00	Dec. 1, 1917
Municipality						
Akron, Ohio	Sewer	500,000	1922–1951	6	101.78	July 1, 1921
Baltimore, Md	City improvement	2,348,000	1922–1925	5	96.51	
	Water	1,929,000	1929–1937	5	96.51	
Camden, N. J	Sewer	224,000	1922–1959	5½	100.922	Aug. 1, 1921
Cincinnati, Ohio	Street railways	1,000,000	1942–1967	5½	101.177	
Colorado Springs, Colo	Paving	200,000	1924–1936	5	93.816	Apr. 1, 1921
Hagerstown, Md	Sewer	300,000	1933–1947	5	95.0823	July 5, 1921
Huntington, N. Y	Road improvement	500,000	1925–1950	5½	103.03	July 2, 1921
Janesville, Wis	Sewer	100,000	1922–1941	6	102.295	July 1, 1921
Lansing, Mich	Street, sewer and bridge repair	500,000	1923–1932	5	94.31	July 15, 1921
Lynn, Mass	School and public work	403,000	1922–1951	5	100.30	
Mt. Vernon, N. Y	Repaving	100,000	1922–1931	5½	100.641	Aug. 1, 1921
Nashua, N. H	Highway	40,000	1922–1936	5	100.00	Aug. 1, 1921
Portsmouth, Va	Street improvement	200,000	1951	5½	96.00	Aug. 1, 1921
Winston-Salem, N. C	Street improvement, water and sewers	325,000	1923–1932	6	100.00	July 15, 1921

Cement Output Increases in August

According to recent information compiled and given out by the United States Geological Survey, the production and shipment of portland cement in the United States increased in August, 1921. The August production exceeded the average for August, 1917-1921, by about 15 per cent. Production for the first eight months of 1921 was about 99 per cent of the quantity produced during the corresponding period of 1920 and exceeded the average for the first eight months of 1917-1921 by about 8½ per cent.

The August shipments exceeded the production, and the total for the eight months just ended is equivalent to more than 99 per cent of the record quantity shipped in the first eight months of 1920. The average for the period during the five years 1917-1921 was exceeded during the past month by about 9½ per cent.

The total production of cement for the first eight months of 1921 is slightly in excess of 62,000,000 bbl.

Illinois Bridge Program for 1922 Is Large

Bids will be received up to Oct. 4, 1921, by the Illinois Department of Public Works and Buildings, Division of Highways, for state bond issue bridge work, a program which entails the construction of 61 bridges with 109 concrete spans and 8 steel spans. The bridges are scattered throughout the state in various counties and along various state routes. Only three of the 61 bridges are to be completed during the 1921 season, the remainder to be completed before the end of the 1922 construction season.

The concrete bridges range in span lengths from 8 to 50 ft., and the eight steel spans in lengths from 100 to 170 ft. Though most of the projects are small, there are three or four large bridges. The largest bridge to be constructed is that near the town of Goodfield and will have four 50-ft. concrete spans and a 170-ft. steel span. The roadway will be 20 ft. wide throughout. Another of the larger projects is the bridge near the town of Goldengate. This bridge will have five concrete spans of a 40-ft. length and a steel span of 125 ft.

Plans for the work may be examined at the office of the district engineer in which the work is located and proposal blanks may be obtained on application in writing from G. F. Sallee, Division of Highways, Springfield, Ill. Plans will not be sent to prospective bidders but upon making a deposit with the district engineer they may be obtained for temporary use while inspecting conditions attending the work in question.

The notice to contractors which has been circulated is full of details regarding the work. Not only are the general data concerning each project given, but the conditions as to availability of local materials, delivery of materials, existing structures, water conditions, depth of excavation, etc., are noted.

Lockwood Housing Investigation Awaits Election

Though Samuel Untermyer, of counsel for the Lockwood joint legislative committee on housing which has been investigating building conditions in New York City, has returned from Europe, it is probable that a continuation of the hearings will not begin until after the municipal elections in November. In the meantime Mr. Untermyer is conferring with Senator Lockwood on methods to be pursued when a continuation is taken.

West Coast Lumber Production

For the week ended Sept. 10, 101 mills reporting to the West Coast Lumbermen's Association reported a production of 52,500,000 ft. b.m., which is 30 per cent below a normal cut. New business totaled 43,000,000 ft. b.m.

Cement Prices Lower

According to an announcement made Sept. 17 by the Universal Portland Cement Co., that company has reduced its selling prices on cement, effective Sept. 17 at its Chicago plant and 15c. per barrel at its Pittsburgh and Duluth plants. This is the second price reduction made by the Universal Co. within the year.

Chicago Building Situation Still Unsettled

The Chicago building situation is still in a decidedly unsettled condition. While the decision of Judge Landis has been accepted by some of the unions and they have gone back to work, pending a rehearing over the wage figures set by him, nevertheless the men have not, in several cases, permitted the use of non-union carpenters, a trade that was not in the arbitration, regardless of the fact that the decision explicitly provided that non-union men might be employed under just these conditions. In the meanwhile much work is being held up and some violence is reported.

The various building material inter-

osts that have been under fire from the Dailey investigating committee (some of them indicted) have been promised speedy trials by the states attorney. Representatives of the cement manufacturers and Portland Cement Association have appeared before the commission during the past week, and the usual reports of "plenty of evidence" have been given out by the commission.

Drop Noted in Number of Bad Order Freight Cars

A further decrease of 17,312 in the number of freight cars idle on September 8, compared with the total on August 31, was shown by reports just received by the car service division of the American Railway Association. The total on the later date was 450,803, of which 237,972 represented serviceable freight cars while 212,831 were in need of repairs.

Tabulations show, however, a decrease of 8,768 in the number of surplus serviceable freight cars in approximately a week, and a decrease within two weeks of 8,541 in the number of bad order cars. This is the first decrease that has been reported in the number of freight cars in need of repairs since last August and would seem to indicate that the rail carriers of the country are making progress in their efforts to get their equipment into shape in order to meet increased demands for transportation facilities.

Standardization of Lumber Is Aim of Conference

At the direct request of one of the regional associations of lumber manufacturers and of a number of associations of retail lumber dealers, including the National Retail Lumber Dealers Association, a meeting to discuss the matter of standardizing lumber sizes and molding patterns will be held in Chicago, at the Congress Hotel, on Oct. 18, immediately prior to the annual meeting of the National Retail Lumber Dealers Association. The United States Forest Service has announced its purpose to engage in lumber standardization of specifications for the purpose of promoting standardization in size of patterns, and representatives of the U. S. Forest Products laboratory will attend the conference.

Employment in Industries

According to a bulletin recently issued by the United States Department of Labor it is found that, comparing figures of August, 1921, with those of identical establishments for August, 1920, in six of fourteen selected industries there were increases in the number of persons employed, while in eight there were decreases. The largest increase—114 per cent—was recorded in the woolen industry. The most important decreases are 43.1 per cent in iron and steel, 36.1 per cent in car-building and repairing, 35.8 per cent in automobiles, and 33.8 per cent in paper.

Queens Borough Has Busy Building Month

During the month of August 1,502 applications for new buildings estimated to cost $8,146,210 were filed with the Bureau of Buildings of Queens Borough New York City. The record for the corresponding month of last year was 628 applications of an estimated cost of $3,125,333. The month of August, therefore, has been the busiest month in the history of the bureau since its organization within the Greater City of New York. Acording to a statement issued by Commissioner of Buildings Moore, the first half of September is keeping up with the August record.

Even more remarkable than the high valuation of the total permits granted is the fact that in 90 per cent of the applications granted construction follows almost immediately.

New Hydraulic Plant Put in Service in California

The Kern Canyon power plant, just completed for the San Joaquin Light & Power Corp. at the mouth of Kern Canyon, 18 miles southeast of Bakersfield, Cal., was put in service Sept. 17. The plant has a capacity of 12,000 hp. and operates under a static head of 260 ft. Water is diverted from Kern River and passes through an 8,300-ft. tunnel to the top of the penstock.

This is the fourth addition to the power system of this company to be completed in the last fifteen months and brings the total amount of energy added in that time to 100,000 hp. The first was a 17,000-hp. unit installed in the Bakersfield steam plant in June, 1920; the Kerckhoff hydro-electric plant on the San Joaquin River, 40 miles from Fresno, with a capacity of 54,000 hp. was completed in August, 1920; and the Midway steam plant, generating 17,000 hp. was placed in operation at Buttonwillow in June, 1921.

Retail Food Prices Increase

The U. S. Department of Labor, through the Bureau of Labor Statistics, has completed compilations showing changes in the retail cost of food in August, in 15 principal cities of the United States. During the month from July 15 to Aug. 15, 1921, there were the following increases in all of these cities: Rochester, 8 per cent; Buffalo, 7 per cent; Baltimore and New York, 6 per cent; Milwaukee, Newark, and Norfolk, 5 per cent; Charleston, S. C., Louisville, Manchester, and Portland, Me., 4 per cent; Houston, 3 per cent; Butte and Dallas, 2 per cent; and Minneapolis, 1 per cent.

For the year period Aug. 15, 1920, to Aug. 15, 1921, there were decreases ranging from 30 per cent in Butte to 22 per cent in New York. As compared with the year 1913, the retail cost of food on Aug. 15, 1921, showed a maximum increase of 62 per cent in Manchester and a minimum of 43 per cent in Louisville.

Jurisdictional Dispute Halts Work on Biltmore Clubhouse

Workmen employed on the new Biltmore Clubhouse, Rye, N. Y., with the exception of carpenters, have been idle for more than a week due to a jurisdictional dispute between the sheet metal workers and carpenters over which craft should do the work of hanging metal doors and window frames. Twelve crafts have gone out, part of them in sympathy with the sheet metal workers and part being forced out by the stopping of engines needed to hoist materials to the upper floors. The international union of the sheet metal workers ordered the men out as a result of the installation of the doors by carpenters and invoking as justification a decision given by the National Board for Jurisdictional Awards in the building industry dated Dec. 4, 1920. This decision gave to sheet metal workers the hanging of hollow metal doors and trim, except sliding doors, in the event that the metal is of 10 gage or lighter. Another decision gave all metal trim work to iron workers in the event that the metal is heavier than 10 gage.

Pennsylvania Builds 520 Miles of Road

Up to and including September 22 the Pennsylvania State Highway Department had completed 520 miles of roadway into which concrete entered in some form. With what mileage remains yet to be put under contract during the present construction season, the total will probably approximate 650 miles for 1921. The state highway department of Pennsylvania believes that to date it has laid more pavement of a durable nature than has ever been recorded by any state highway department.

Civil Service Commission To Appoint Statistician

The United States Civil Service Commission has announced an open competitive examination for statistician. A vacancy in the position of statistical analyst in the Interstate Commerce Commission at a salary of from $3,600 to $5,000 a year and vacancies in positions requiring similar qualifications at these or higher or lower salaries will be filled from this examination. The duties of the position require special training in statistical methods, together with familiarity with railroad statistics. The appointee will be required to assist in the analysis of the financial and operating reports filed by carriers and must be capable of conducting independent research. Graduation from a college or university of recognized standing and three years' graduate work in economics, statistics, or transportation are prerequisites.

Applicants should at once apply for form 2118, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C., or to

the Secretary of the United States Civil Service Board in any of the designated cities.

New Funds Needed to Continue Pennsylvania's Road Program

At the close of the year 1922, according to a bulletin just issued by the Associated Pennsylvania Highway Contractors, Pennsylvania will have entirely exhausted all funds available for road construction unless the voters of the state, in the primary election of Sept. 20, authorize a constitutional convention which will incorporate in a new state constitution provisions to enable the commonwealth to issue additional bonds for highway construction. If the vote is favorable delegates will be elected in November and the convention will convene early next year, finish its work and submit its findings in November, 1922, when the new convention will be submitted for ratification to popular vote. Unless this course of procedure is followed the Associated Pennsylvania Highway Contractors predict that highway construction at the present rate will be halted at the end of the year 1922.

Contracts Total $123,000,000

Contracts let during the past week, as reported in *Engineering News-Record*, amount to more than $22,000,000, a high figure for this time of year. This brings the total for the month of September to about $123,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 1, the next, on October 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.88	$4.00	$4.00	$2.88	$3.16	$4.00	$3.70	$3.75	$4.00
Structural rivets, 100 lb.	3.70	5.25	5.50	3.68	4.15	4.25	5.50	5.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb.	2.78	—3.20	3.50	2.78	3.18	3.57½	2.35	3.75	3.75
Steel pipe, black, 2½ to 6 in. lap, discount	51%	52.65–5%	45%	65½%	58.9–5%	38%	—51.8%	55%	5%
Cast-iron pipe, 6 in. and over, ton	47.30	40.50	+53.50	45.60	47.80	52.00	60.00	55.00	70.00
Concreting Material:									
Cement without bags, bbl.	2.50	2.69	2.80	1.97	2.26	3.10	2.89	3.10	3.10
Gravel, ¾ in., cu.yd.	—2.00	2.13	3.00	1.65	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd.	1.25	1.35	2.50	1.65	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.80 to 1.90	2.25	2.80	1.75	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	45.00	35.00	35.00	46.00	34.00	49.00	28.00	21.50	120.00
Lime, finishing, hydrated, ton.	16.99	19.00	25.00	18.00	29.00	30.00	25.40	24.00	21.00
Lime common, lump, per bbl.	3.69	1.60	2.75	—1.40	1.40	2.95	2.25	2.75	15.00
Common brick, delivered, 1,000.	18.40@19.40	10.00	12.72	11.00	17.00	14.00	18.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.14	.124	.0821	.092	.09	.12½	.11	.15
Hollow partition tile 4x12x12, block	.11370	.14	.124	.0657	.092	.10	.14½	.12	....
Linseed oil, raw, 5 bbl. lots, gal.	.80	+.86	.98	.87	—.86	.98	.91	.79	.88
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	.72½	.50	.50@.55	.81½	.75	....
Common labor, non-union, hour.	.....	.20	.35@.45	.35@.40	.50	.35@.40	.50@.55	.50	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.70 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

Changes Since Last Week

Mill quotations on structural steel shapes and plates prevail at $1.60@1.70; with bars at $1.65@1.70 per 100 lb., in small tonnages. Mill shipments, New York, of structural shapes and plates are quoted at $1.98@203; with bars at $1.88@1.98 per 100 lb. Dallas quotes mill shipments of reinforcing bars at $3.05. Shipments of steel shapes from the mill via all rail to Minneapolis are quoted at $2.45; by lake and rail, $2.51 per 100 lb. Steel warehouse prices have shown considerable firmness throughout the week, with the exception of reinforcing bars, which are quoted in Atlanta at $3.20 as against $3.25 per 100 lb. San Francisco reports an increase of 5 per cent in discounts on black steel pipe. An advance of 20c. per ton is quoted on cast-iron pipe in Dallas.

The market for concreting materials has remained firm; with marked increase in volume of business, particularly in crushed stone. New York, however, quotes gravel at $2 as against $2.25 per cu.yd., alongside dock.

Common lump lime is quoted in Chicago at $1.40 as compared with $1.50 per bbl. previously. This price applies to 180 pounds net.

Linseed oil is quoted at 86c. per gal. (5 bbl. lots) in Minneapolis and Atlanta.

Reports from Oakland, Cal., state that a gradual increase in construction work is noticeable, particularly in the Bay region. A strike of seven thousand five hundred oil workers in the producing sections of California threatens to creat a serious situation all along the coast unless speedily settled.

Minneapolis reports that at least 20 per cent of the skilled mechanics in the building trades are out of employment at present. There appears to be still greater unemployment among unskilled laborers in this vicinity. No unemployment, however, is reported among plasterers.

With the opening up of sixty-five steel and tin mills in the Ohio district alone, employment will be furnished for several thousand men. Some of these industries have not been in operation since the first of the year.